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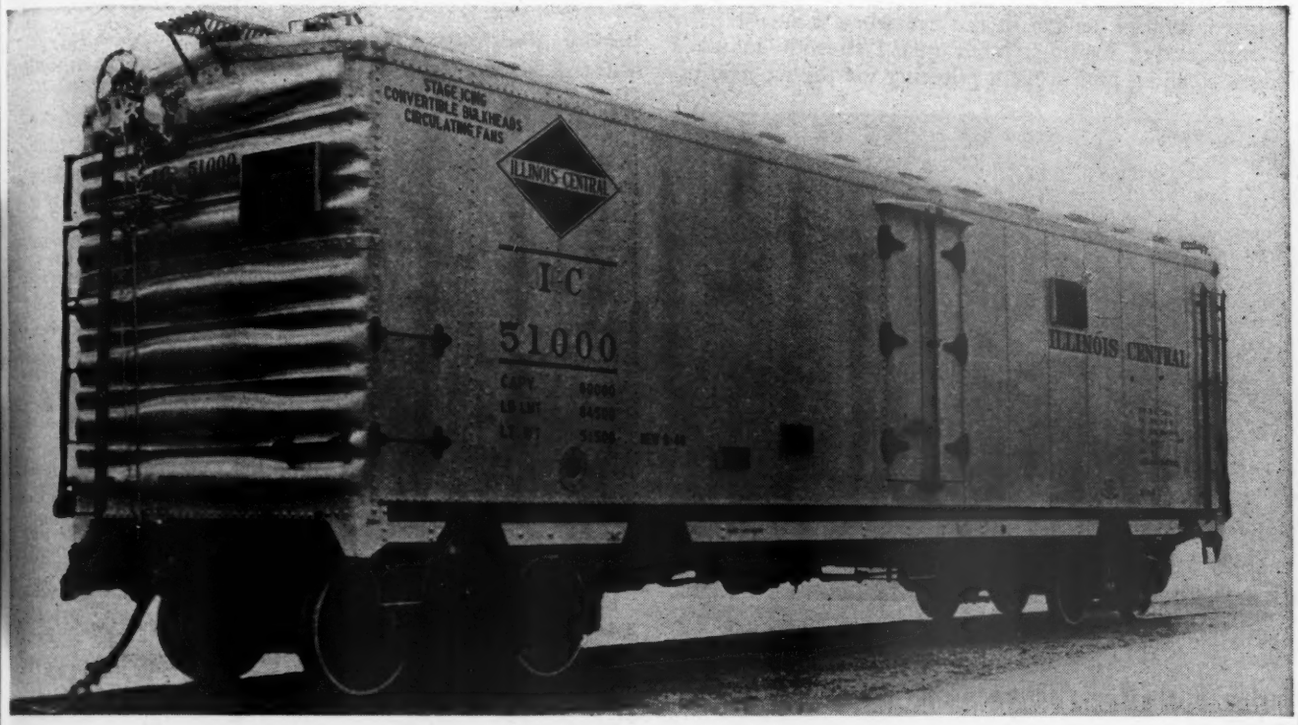


Illinois Central

Aluminum Refrigerator Car

Conforms to the United Fresh Fruit and Vegetable Association specifications — Features include the Duryea underframe, A-3 easy ride trucks, convertible bulkheads, stage icing and forced circulation of air

AN EXPERIMENTAL aluminum-alloy refrigerator car, designed to meet the specifications of the Refrigerator Car Committee of the United Fresh Fruit and Vegetable Association, was completed by the Illinois Central at its McComb, Miss., shops late last September. It is unusually heavily insulated, and is designed to provide smooth operation, and reduced maintenance expense.

The car, of 40 tons nominal load-carrying capacity, has an inside clear length between bunkers of 33 ft. 2¾ in.; inside width between flue lining, 8 ft. 3 in.; inside height, floor to ceiling, 7 ft. 10½ in.; and inside height, floor rack to ceiling, 7 ft. 3 in. The lightweight of the car ready for service is 51,500 lb., or 2,500 lb. more than originally estimated owing to the inclusion of a number of mechanical features involving heavier construction. As shown in one of the tables, the parts of this car which are made of aluminum alloys weigh 10,166 lb. and would have weighed 22,663 lb. in steel, the indicated weight saving in favor of aluminum construction being 12,497 lb.—nearly 6¼ tons.

The new aluminum refrigerator car was built according to plans formulated in the last two years by the Refrigerator Car Committee of the United Fresh Fruit and Vegetable Association and represents the best combined thought of this committee and the Illinois Central for a light, but strong, all-purpose, low-temperature, easy-riding, ice-cooled car. Collaborating in details of the design were the Aluminum Company of America which furnished the aluminum alloys, a number of specialty manufacturers and the Car Construction Committee of the Association of American Railroads which has specified the procedure to be followed in extensive service tests.

In addition to maximum weight saving consistent with strength requirements by the use of Alcoa aluminum alloy construction, general features recommended for inclusion in the car design were as follows: Standard interior dimensions to facilitate transporting package goods in

containers of standard size; effective insulation with Ultralite Fiberglas, 4½ in. thick in the roof and floor and 4 in. thick in the side walls and ends; Preco built-in fans for positive circulation of cool air from the floor through ice boxes to the ceiling; air ducts for the protective cooling of side walls and better distribution of the air over, around and under the load; ice boxes with convertible bulkheads to fold back and allow about 6 ft. increased interior length in the car when it is used for non-refrigerated loading; inner guard to slide in place along the ceiling and prevent pilfering via the ice-loading

Roof, running board and hatch cover

hatches in the roof; electric lights for loading and unloading.

Additional suggestions included easy-riding trucks using long-travel springs and built-in stabilizers in the truck bolsters, Duryea underframe with resilient attachment to the center sill to cushion longitudinal shocks, aluminum floor racks instead of wood for greater cleanliness, sanitation and non-retention of odors in handling foodstuffs, synthetic rubber in place of felt to seal the ice loading hatches and car doors.

The recommendations of the committee were followed closely and the car constructed of aluminum materials and parts shown in Table I and non-aluminum parts in Table II. The weight savings are shown in Table III.

Table I—Materials and Parts Made of Aluminum for the I. C. Refrigerator Car

Sheets, bolts, rivets, special extrusions and castings, furnished to specialty companies	Aluminum Company of America, Pittsburgh, Pa.
Defect-car receptacles	Apex Railway Products Company, Chicago
Ice bunkers, convertible bulkheads, bunker pans, and hatch-operating mechanism	Union Asbestos & Rubber Co., Equipment Specialties Division, Chicago
Watertables, corner bands, cross-bearer bottom chords, side-sill connection at bolsters, end sills	General American Transportation Corp., Chicago
Running board and brake step	Morton Manufacturing Company, Chicago
Blower fans and fan housings	Preco, Inc., Los Angeles, Calif.
Corrugated ends, corner posts, roof, end plates, top corner cap, hatch frames, covers, running board saddles	Standard Railway Equipment Manufacturing Company, Chicago
Ice grates, end posts and bunker reinforcing beams	Transportation Specialties Company, Chicago
Handbrake housing, brake wheel and bell crank	Universal Railway Devices Company, Chicago
Floor racks, hinges, latches and well trap	Union Railway Equipment Company, Chicago
Fabricated sides and watertables	Youngstown Steel Door Company, Chicago

Table II—I. C. Refrigerator Car Parts Not Made of Aluminum

Duryea cushion underframe parts	General American Transportation Corporation, Chicago
A-3 ride control trucks	American Steel Foundries, Chicago
Brake shoes and brake-shoe keys	American Brake Shoe Company, New York
Bolster springs	American Locomotive Company, Railway Steel Spring Division, New York
Jenkins leather fiber dust guard	Ajax-Consolidated Company, Chicago
Steel wheels	Carnegie-Illinois Steel Corp., Chicago
Dust-guard plug retainers	Central Railway Supply Company, Chicago
Brake-beam supports	Chicago Railway Equipment Company, Chicago
Brake-beam hanger lock and retainer keys	Illinois Railway Equipment Company, Chicago
Journal bearings	Magnus Metal Corporation, N. Y.
Journal box lids	National Malleable & Steel Castings Company, Cleveland, Ohio
Tubular steel axles	Pittsburgh Steel Company, Pittsburgh, Pa.
Brake levers, brake beams, hangers and bottom connections	Schaefer Equipment Company, Pittsburgh, Pa.
Journal box packing retainers	Spring Packing Corporation, Chicago
Side bearings	Standard Car Truck Company, Chicago
Side door inner seal	Bridgeport Fabrics, Inc., Bridgeport, Conn.
Caulking compound, Alumalastic	Parr Paint & Color Works, Cleveland, Ohio
Insulation compound	Dednox, Inc., Chicago
Angle cocks and train line U-Bolt nuts	Grip Nut Company, Chicago
Insulation, Fiberglas	Gustin-Bacon Manufacturing Company, Kansas City, Mo.
Plywood	Harbor Plywood Corporation, Hoquiam, Wash.
Retaining valve and branch pipe tee anchors, draft-key retainers, pipe clamps	Illinois Railway Equipment Company, Chicago
Side door thresholds	Johns-Manville Sales Corp., N. Y.
Liquidometers	Liquidometer Company, Long Island City, New York
Car cement	Milar & Company, Chicago
Side-door locking arrangement	W. H. Miner, Inc., Chicago
Watertight bolts and nuts	MacLean-Fogg Lock Nut Company, Chicago
Stencilling material, Scotchlite	Minnesota Mining and Manufacturing Company, St. Paul, Minn.
Couplers	National Malleable and Steel Castings Company, Cleveland, Ohio
Air brakes	New York Air Brake Company, N. Y.
Brake regulator	Royal Railway Improvements Corp., Wilmington, Del.
Ceiling light fixtures	The Safety Car Heating and Lighting Company, Inc., N. Y.
Cushion coupler carrier and uncoupling mechanism	Standard Railway Equipment Company, Chicago
Side-door hinges	Union Railway Eqpt. Co. Chicago.

Wood parts of the car, pressure treated by the zinc-chloride process

Aluminum alloys used in this car were especially selected to obtain maximum resistance to corrosive attack in service. The Alcoa alloy 61S-T, used for the ends, roof and floor racks, is a heat-treated aluminum alloy characterized by a yield strength somewhat higher than that of low-carbon structural steel, good formability and weldability, and excellent resistance to corrosion. It owes its high resistance to corrosion to the fact that the principal alloying constituent (Mg_2Si) has an electrode potential of the same order as that of aluminum and hence does not promote electrolytic attack of the alloy under any condition of thermal treatment. The small amount of copper present is in solid solution and hence increases the strength without appreciably decreasing the resistance to corrosion.

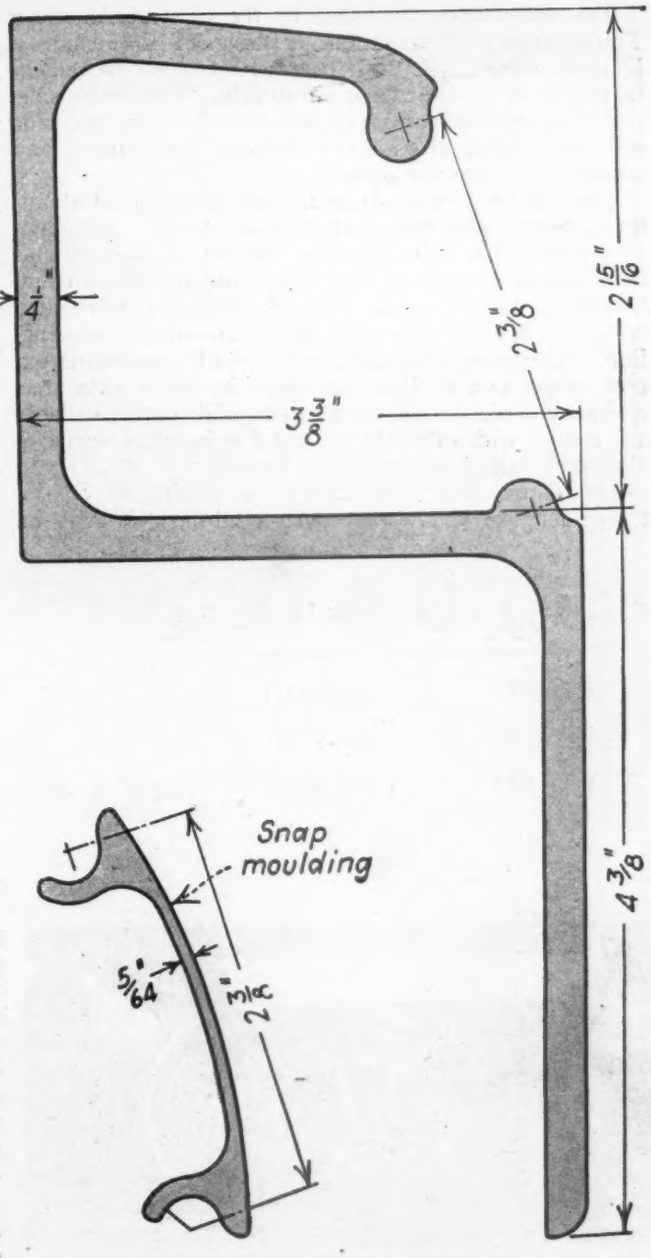
Table III—Estimated Weight Saving by Aluminum Construction in I. C. Refrigerator Car

Car part	Weight in aluminum, lb.	Weight in steel, lb.	Saving by use of aluminum, lb.
Bulkhead with Utility door	1,667	3,750	2,083
Ceiling beam	103	235	132
Drip pan	154	393	239
Hatch fixtures	51	110	59
Running board	175	321	146
Improved riveted roof	741	1,927	1,186
Dreadnaught ends	961	2,669	1,708
Hatch carline and frame	178	388	210
Hatch cover	109	321	212
Stage grates	150	350	200
End ports	52	126	74
Reinforcing beams	192	445	253
Handbrake	60	100	40
Floor rack	940	1,700	760
Outside well trap	30	72	42
Preco ventilating fans	300	630	330
Car sides	2,768	6,086	3,318
Underframe	508	1,000	492
Construction bolts and rivets	272	540	268
Shapes, sheets, tubes, etc.	755	1,500	745
Totals	10,166	22,663	12,497

Alclad 3S and 61S-T sheet, used for drip pans and bunkers, consist of products in which the core alloy is covered on both surfaces with thin, non-porous layers of an aluminum alloy (Alcoa 72S) containing 1 per cent of zinc, metallurgically bonded to the core. This alloy is anodic to the 3S and 61S core alloys and hence electrolytically protects areas of the core exposed at the cut edges or by abrasion or corrosion. Penetration by corrosion into the core is prevented as long as appreciable areas of 72S coating remain. The coating itself is high-resistant to corrosion by salt water.

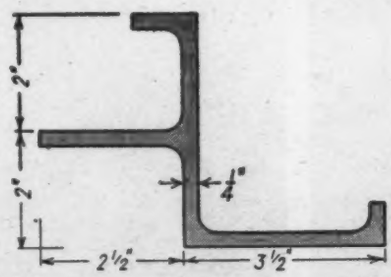
Alclad 14S-W, used in side sheets, has a coating of a magnesium silicide alloy (Alcoa 53S) which responds to the same heat treatment as the Alcoa 14S and hence is somewhat harder than the coatings used on the other alclad products. The copper present in solid solution in the 14S-W core lowers the electrode potential of the core so that the magnesium silicide alloy coating is anodic.

Roof corner and other miscellaneous castings are made of Alcoa 220 and 356 because of their high resistance to corrosion. Alcoa 220 alloy contains about 10 per cent magnesium and possesses an excellent combination of strength and shock resistance. Alcoa 356, used for well traps, has good casting characteristics and is readily joined to other structural members by welding.

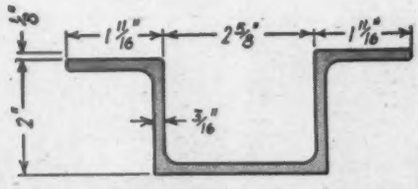


Side plate and snap moulding aluminum extrusion

The new I. C. refrigerator car is distinctive in appearance, with rounded outside eaves and corners and the aluminum exterior simply cleaned with Oakite and left in its natural bright finish. The monogram and identification markings are Scotchlite green reflective material and other stenciling, safety appliances, door fixtures and trucks are painted a conventional black. A narrow green band is painted over each side sill for decorative purposes.



Extruded aluminum door post (left) and side post (right)



The car interior is assembled so as to permit complete removal of flue lining, body lining, belt rails and insulation for periodic inspection of insulation and aluminum.

The underframe, furnished by the General American Transportation Corporation, is designed to include a Duryea cushion-type draft gear with coupler movement limited to ¾ in. and center sill to 7 in. The center sills, body bolsters and cross bearers are steel and the side sills, end sills, cross-bearer bottom connections and corner bands are aluminum.

The side posts and plates are special extruded aluminum shapes and the corner post pressed aluminum W-shapes. The side sheathing consists of ⅛-in. aluminum panels extending from side plate to side sill and lapped at the side post. The Dreadnaught corrugated ends and Murphy roof are also of aluminum construction. Aluminum rivets are used for all connections except where one or both are steel, in which case steel rivets are used. All aluminum joints and contact surfaces are coated with Alumalastic and inside metal surfaces, also steel contact surfaces, with Dednox.

The entire floor construction is 1¾-in. by 5¼-in. t.-&-g. longleaf yellow pine over a sub-floor of $^{13}/_{16}$-in. by 6-in. ship-lap lumber which is nailed to six 3-in. by 5-in. longitudinal stringers. These stringers are cut out where necessary to receive and support the pan rails and drip pans. A No. 14 gage aluminum flashing extends 12 in. on the floor and is turned up 4 in. at the bottom side rail. The top surface of the floor is covered with a water-tight membrane extending into the drip pans and 4 in. up the side walls. This membrane is made by mopping the main floor with a heavy compound, applying a lower course of No. 35 fabric, a second coat of compound and a final course of No. 55 felt with the top surface sand impregnated. All joints are butted and staggered.

The inside finish consists of $^{9}/_{16}$-in. Super-Harbord plywood for side and end walls, a flue lining of the same material being spaced 1½ in. out from the side walls and extending from 1 in. below the floor rack top to within 6 in. of the ceiling to provide an air duct on each side of the car. The ceiling panels are ½-in. plywood. All lumber used in the car except the hot-pressed waterproof plywood was pressure treated to resist decay with chromated zinc chloride by the Koppers Company, Wood Preserving Division.

Side and end-wall insulation include one course of ¼-in. board-type insulation applied against the side posts or corrugated ends, with two courses of 2-in. Fiberglas held in place with wood belt rails and spacers and one course of 90-lb. waterproof paper next to the inside lining. The floor and roof insulation are essentially the same except that one of Fiberglas blanket is 2½ in. thick, giving a thickness of 4½ in. for the two courses.

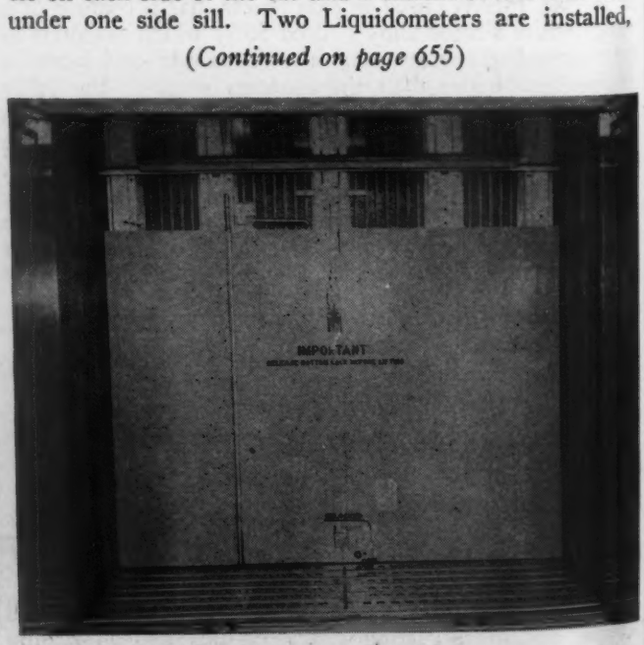
The hinged side doors are made with wood frames in two sections to fit a 4-ft. wide by 6-ft 7¾-in. high clear opening on each side of the car. The doors have the equivalent of car-body insulation and are sealed all around with a double-rubber seal suitably recessed.

Each ice-bunker bulkhead, made of aluminum, has a utility door and Transco suspended-type half-stage ice grates which swing downward when not in use. The hatches and covers also are aluminum, the latter having a rolled safety tread on top, integral plug and Equipco gasket-type seal.

The car is wired for electric lights using two 40-watt, 110-volt recessed ceiling lamps, with an outside receptacle on each side of the car and a thermo switch mounted under one side sill. Two Liquidometers are installed,

(*Continued on page 655*)

Portable electric-motor fan-drive for precooling while loading



Convertible bulkhead with utility door open to show half-stage ice grates (left)—Bulkhead in position against the car end (right)

Santa Fe 6,000-Hp. Diesel

Three-unit locomotive built by Alco-General Electric is powered by V-type 16-cylinder Diesel engine developing 2,000 hp. at 1,000 r.p.m.

THE seventy-five thousandth locomotive turned out of the Schenectady Works of the American Locomotive Company is the new three-unit, 6,000-hp. Diesel-electric built for the Santa Fe in collaboration with General Electric Company. This locomotive incorporates a new 2,000-hp. Turbosupercharged Diesel engine of the V-16 type and a number of new developments in electrical equipment. Each of the three units—two A units and one B unit—has an over-all length of 66 ft. 2 in. with a unit wheel base of 49 ft. 8 in. The total weight of the A unit is 306,000 lb. supported on six axles and the B unit weighs 300,000 lb., likewise supported on six axles. Each unit has capacity for 230 gal. of lubricating oil, 1,200 gal. of fuel oil and 1,000 gal. of water for steam heating. Each unit has one power plant, a steam generator and, except or operator's cab on A units, are identical in arrangement of equipment.

The Diesel engine is a new V-type Alco design introduced with this locomotive. It is known as the Series 244, has 16 cylinders of 9-in. bore and 10½-in. stroke and develops 2,000 hp. at 1,000 r.p.m. The engine was designed for the application of the General Electric supercharger, described elsewhere in this article.

The engine is the four-cycle type with two intake and two exhaust valves in each cylinder head. It has unit fuel injection, water-cooled cylinder liners and heads, trunk type oil-cooled pistons, forged-steel connecting rods, a nine-bearing forged crank shaft and a welded base and cylinder block.

Fuel is fed from the main supply to the injection pumps by an electric-motor-driven transfer pump located in the engine compartment. The supply pipe is filter-equipped, with a waste-packed filter on the suction side and a felt filter on the discharge side.

A gear-type pump supplies full pressure lubrication to all parts of the engine. The lubricating oil reservoir, of 230 gal. capacity, is located in the engine base. The lubrication system is filter-equipped and the oil is cooled by a single-pass type cooler. The engine is automatically stopped in case the lubrication system fails to operate properly.

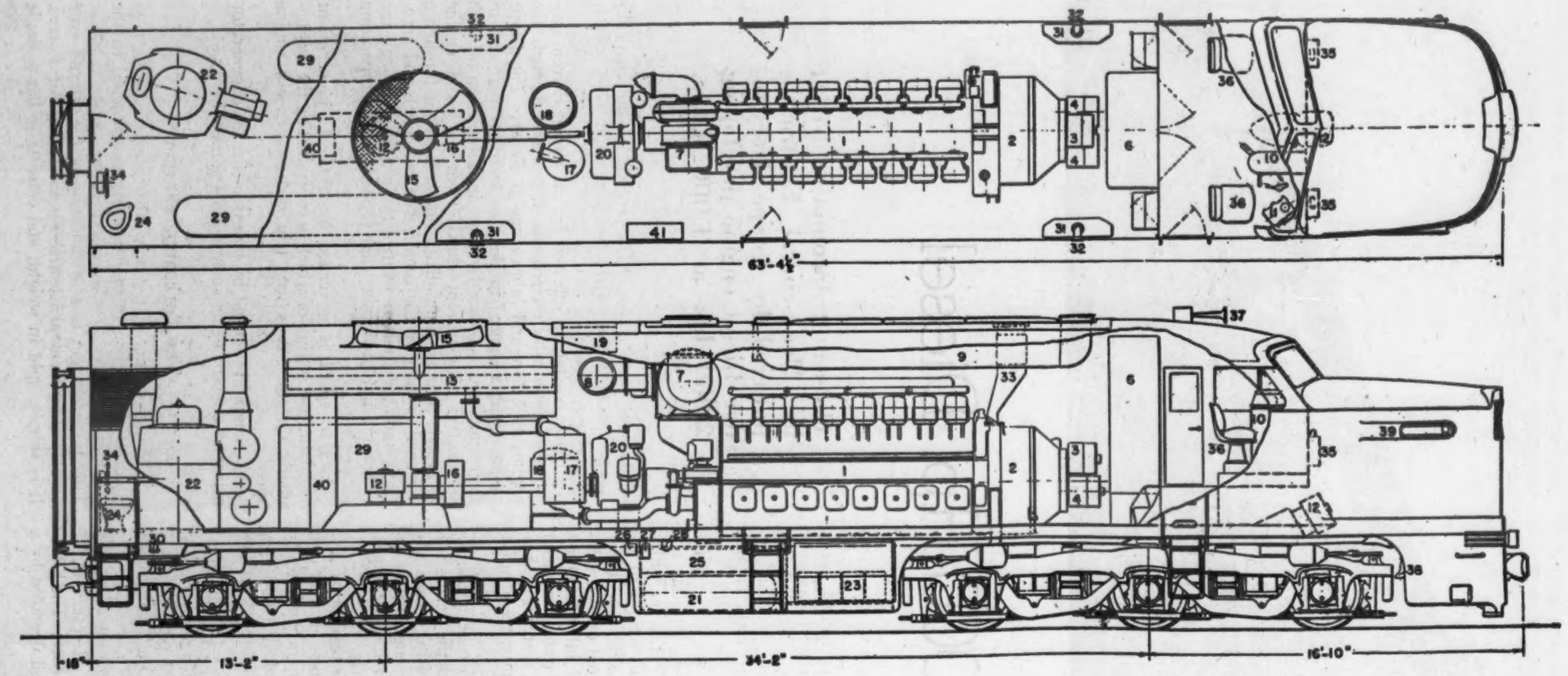
Engine cooling is effected by an engine-driven centrifugal pump which circulates the water through the engine, radiators and lubricating-oil cooler. Panel-type radiators are mounted in the roof over the rear end of the engine, and a cooling fan mechanically driven through an electric eddy-current clutch from the main engine draws air through the radiator and exhausts it through a screened opening in the room. The fan clutch and automatic radiator shutters control the air flow through the radiators and maintain the proper engine operating temperature.

Engine speed is governed by a G. E. power-plant regulator, the setting of which is controlled by the engineman's throttle. A safety trip controls excess engine speed.

The engine is started by means of the main generator acting as a motor using current from storage batteries.

The Turbosupercharger

The high output of the new Alco engine is made possible by the higher supercharging pressure used in the constant-pressure Turbosupercharging system. The Turbosupercharger is a modification of the aircraft type developed by General Electric for the Army Air Forces. It is simple, light in weight, and consists of but a single



1—Engine
2—Main generator
3—Exciter
4—Auxiliary generators
5—Traction motors
6—Contactor Compartment
7—Turbosupercharger
8—Turbosupercharger filters and silencers
9—Dynamic brake grids and blowers (modification)
10—Control stand
11—Brake valves
12—Traction-motor blowers
13—Radiators
14—Radiator shutters
15—Radiator fan
16—Radiator-fan clutch
17—Lubricating oil cooler
18—Lubricating oil filters
19—Engine water tank
20—Air compressor
21—Main air reservoirs
22—Steam Generator
23—Batteries
24—Toilet
25—Fuel tank
26—Fuel-tank filling connection
27—Fuel-tank gauge
28—Emergency fuel cut off
29—Water tanks
30—Water-tank filling connections
31—Sand boxes
32—Sand-box filling holes
33—Generator air duct
34—Hand brake
35—Cab Heaters
36—Seat
37—Horn
38—Bell
39—Number box
40—Tool box
41—Engine-control panel

Sectional elevation and plan of Alco-GE Diesel-electric locomotive (2,000-hp. A unit)

unit operating from one exhaust manifold connecting all cylinders. The unit itself weighs 1,400 lb.

With a Turbosupercharger of this type the potential output of a normally aspirated engine can be increased 85 to 90 per cent.

With the Turbosupercharger the cylinders are not only thoroughly scavenged but cylinders and the exhaust valves are cooled by the air stream, maintaining normal head and valve temperatures.

Electric Transmission

The electric transmission system, consists of the main generator, an amplidyne exciter, and four traction motors, one mounted on each of the four driving axles. Two gear-driven auxiliary generators are also included; one to supply power for lights, battery charging, control, and all other auxiliary load; the other to supply power for motor-driven traction-motor blowers.

The 10-pole generator is a newly designed machine and is built with a single, low-voltage, shunt-exciting winding for amplidyne excitation. Designed specifically to operate with the new high-speed Alco Diesel engine, it is rated 2,000 hp. at 1,000 r. p. m. This is the first time a generator for locomotive service has been rated at this speed and capacity. Weighing only 10,000 lb., it develops 31 per cent more power per pound of weight than the last previous model.

The traction motors are GE-726 motors which have high continuous and short-time tractive ratings. Optional gearing ranges from 65 to 120 m. p. h. The most unusual feature of the electric transmission system is the amplidyne exciter. Mounted on the generator and connected into the shunt field winding of the generator, this device functions basically as an exciter, increasing or decreasing generator output by increasing or decreasing current supplied to the field winding.

As an exciter, the amplidyne can utilize exceptionally low current from the control circuit and amplify it sufficiently to obtain a volume of excitation current large enough to modify generator output promptly.

By harnessing an internal short-circuit and putting it to work, the amplidyne can magnify a control current as much as 10,000 to 1 and can reach full required output in one-tenth of a second or less. As a result of these two characteristics, the amplidyne makes possible the use of low control current with correspondingly small, compact, fast-acting control devices.

Electric Control System

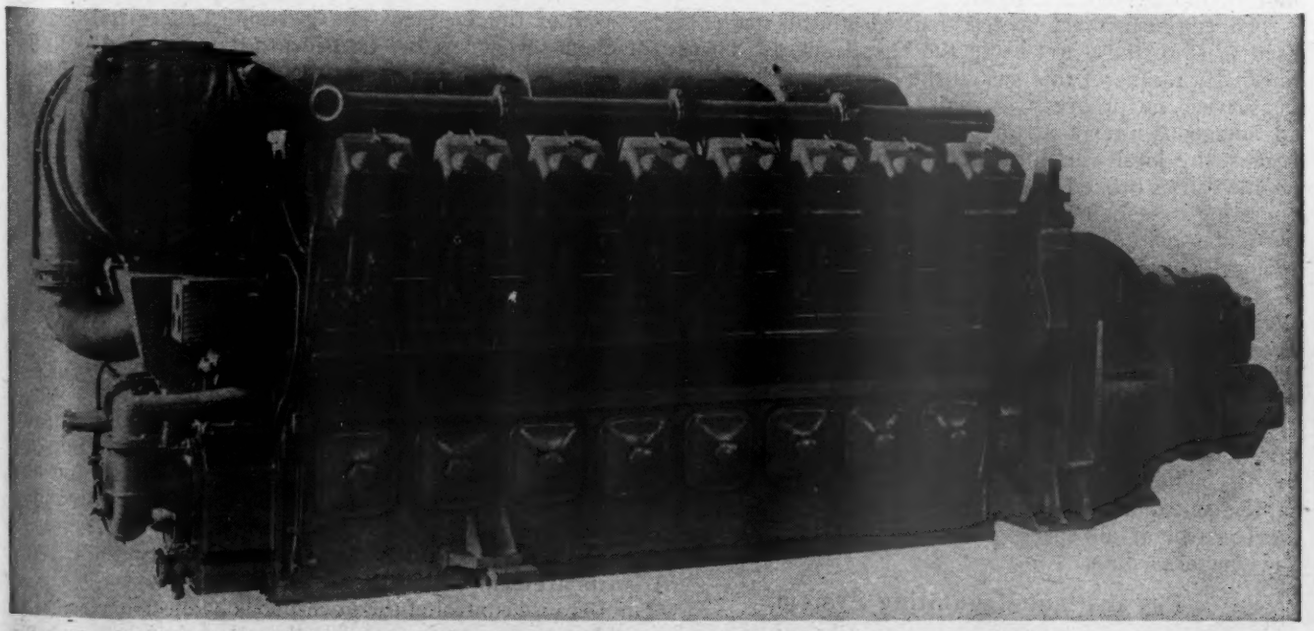
The control system of the locomotive has been organized into three separate compartments—the engineman's control station, the contactor compartment, and the engine control panel. By so grouping the various electric equipment, it has been possible greatly to simplify the wiring, keeping cable runs to minimum lengths.

Easy identification and accessibility are stressed. Every piece in the three control centers is identified by an individual nameplate. Through use of multi-point connection plugs, whole assemblies can be connected and disconnected easily.

It has also been possible to build "packaged" units of equipment, which can be given maximum protection consistent with their function. In this way, entire assemblies can be easily removed from the locomotive for repair and a replacement unit installed, thus enabling the locomotive to go back into revenue service. The control relays in the contactor compartment can be handled as one unit in this manner, as can the entire engine-room control panel, and other components of the control system.

In laying out the engineman's control station, every effort has been made to increase the efficiency with which the engineman can work and thereby permit safer locomotive operation on tighter schedules. Through the use of the amplidyne exciter and small relays—plus modern compact control devices—it has been possible to locate controls for maximum accessibility in accordance with the frequency and importance of their use. Throttle, reverser, and selector handles are all within easy reach. The headlight switch has been placed conveniently on the control stand. Engine-temperature and oil-pressure warning lights are prominently located so as to be visible to both engineman and fireman.

Special attention has been given to the lighting of the engineman's control station. Taking a lesson from the Army Air Forces, engineers have installed large size scales on load indicator, speed meter, and air-brake gauges, and have illuminated the entire panel with ultra-violet ("black") light. The level of illumination is also



The power plant for the Alco-GE 2,000-hp. Diesel-electric road locomotive—The GE Turbosupercharger (left), and the new 10-pole generator and the gear-driven auxiliary generators and amplidyne exciter (right)

Sectional elevation and plan of Alco-GE Diesel-electric locomotive (2,000-hp. A unit)

adjustable to suit individual requirements. As a result, the problem of "dark adaptation"— which results from looking into the dark night, glancing down at glaring indicator lights on the dashboard, and then trying once again to adjust the eyes to external darkness—has been eliminated.

Contactor Compartment

The contactor compartment, is located immediately behind the engineman's cab and forms the forward wall of the engine room. In it are located the circuit breakers, resistors, and other devices which control the main power supply. No device in the compartment is located behind another and all are arranged for maximum accessibility, with those parts most subject to wear, located where they can be most easily reached.

Application of the amplidyne excitation system permits the use of small type operating relays which are located inside a dust-tight removable box. This eliminates, to a large degree, failures due to dirt, and makes for longer relay life. The entire assembly is fitted with quickly removable plugs and the box, with relays, can easily be lifted out for repair or unit exchange.

All heat-producing elements of the control system and particularly the field shunt resistors are located at the rear of the compartment and are partitioned off to prevent heat reaching other equipment. Heat given off by these devices is exhausted into the engine room where it is removed by the engine-room ventilating system.

Another improvement in the control system is the complete elimination of fuses. All control and auxiliary power circuits are protected by new switch-type, trip-free, indicating circuit breakers. Because the position of the circuit breaker toggle indicates at a glance the position of the breaker, identification of a faulty circuit is made easy. In the event of a transient fault, the breaker can be reclosed manually without interrupting service.

Engine Control Panel

Mounted to a side wall of the engine room, the engine control panel contains all equipment necessary to start and regulate the operation of the Diesel engine. Like the voltage regulator, motor cut-out switch, and the operating relays, the entire panel can be removed as a unit for replacement and repair.

The engine control switch, located in this panel, is used to stop, start, and bring the Diesel engine "on the line." By means of this switch the engine can be placed in service in progressive steps. This is particularly advantageous after a major replacement of engine parts, because by locally limiting maximum engine speed, the engine can be broken in gradually. Also, if for any other operating reason it is desired to confine operation of a particular engine to a condition of reduced speed and reduced load, the engine control switch can be left in one of the "step" positions below the "run" position.

In this way, a new engine can be broken in during operation of a multiple-unit locomotive with no risk of damage to the power plant by full-speed operation. Up to the limit imposed by the engine control switch, the engineman can use the power of such an engine to gain additional tractive force for starting or to overcome a grade condition. And when the engine has been broken in, the control switch can be turned to the "run" position, and control at all speeds reverts to the engineman at the control position.

Power-Plant Regulating System

The power-plant regulating system is used automatically to govern the operation of the power plant to meet—insofar as it is safe and possible—the performance called for by the engineman. It holds constant any preset engine speed, limits engine torque, and adjusts the generator demand to suit the engine's ability to deliver power at any moment.

Looking at one of the Alco V-16 engines from the generator end of the engine room

Its advantages are its great stability, high responsiveness, ready adaptability to remote control, and its incorporation of engine protective features not normally found in other types of governors.

The system consists of a tachometer generator and the governor, both mounted on the Diesel engine but connected to each other only by electric cable. The tachometer generator is driven by the Diesel engine and hence its electric output is directly proportional to the speed of the engine. The governor, energized by the tachometer generator, transforms the electrical impulse from the tachometer generator into mechanical action to control the fuel racks of the Diesel engine. Through the amplidyne exciter it also controls generator demand.

Stability of this system in maintaining constant engine speed is obtained by built-in, rapid anti-hunting features which include momentary reversal of excitation whenever necessary to control speed. Because it is sensitive to changes in excitation, the governor can actually anticipate a change in generator demand and adjust the fuel rack setting to compensate for the change before it occurs.

On the other hand, should the engine for any reason become unable to deliver full power, the governor automatically unloads the generator until the engine is again operating at rated speed. This ability to maintain constant engine speed despite fluctuations in load and engine ability should greatly increase the life of the engine and its parts. Proper circulation of lubricating oil and cooling water are automatically maintained, and as a result operating temperatures and clearances between moving parts are held within the designed limits.

Because control of the governor is by electric circuits to a rheostat on the throttle handle rather than by mechanical linkage to the throttle handle, manual and automatic controls may be located any desired distance from the

General Characteristics of Alco-G. E. 2,000-Hp. Diesel-Electric Locomotive

Wheel arrangement	A-1-A A-1-A
Diesel engine (one per unit) hp	2,000
Over-all dimensions, ft.-in.:	
Height (roof)	14-0
Height (maximum)	14-11
Width inside cab sheets	9-9¼
Width (maximum)	10-6½
Length over-all (A unit)	66-2
Length inside knuckles (A unit)	65-8
Length over-all (B unit)	64-0
Length inside knuckles (B unit)	63-6
Length over knuckles, three units	195-4
Wheel bases, ft.-in.:	
Truck, rigid	15-6
Each A or B unit	49-8
Total locomotive (three units)	176-8
Truck wheels, diameter, in.	40
Maximum track curvature, deg.	21
Weights, lb.:	
On drivers, A unit	204,000
Total locomotive, A unit	306,000
On drivers, B unit	200,000
Total locomotive, B unit	300,000
Per axle, maximum, A unit	51,000
Supplies:	
Fuel oil, each unit, gal.	1,200
Lubricating oil, each engine, gal.	230
Engine-cooling water, each engine, gal.	300
Steam-heat water, each unit, gal.	1,000
Sand, each unit, cu. ft.	22

prime mover, and multiple-unit operation is readily accomplished. Lack of mechanical parts likewise means fewer parts subject to wear and hence a longer wearing, more accurate system.

Built-in safety features include protection against engine overspeeding, low lubricating-oil pressure, low regulator-oil pressure, high engine temperature, and electrical ground. The system is so designed that it always "fails safe"; that is, in case of any trouble, the fuel into the engine is automatically shut off and the exciter circuits opened.

Dynamic Braking

The dynamic braking is accomplished by reversing the action of the traction motors, that is, using them as generators and dissipating the electrical energy in a loading resistor. The circuit for the braking operation is set up by a braking switch which connects the motor armatures of a cab to the loading resistor. The motor fields of each cab are connected across the traction generator and control of the amount of braking is accomplished by varying the excitation on the generator. This is accurately regulated through the use of the amplidyne excitation system.

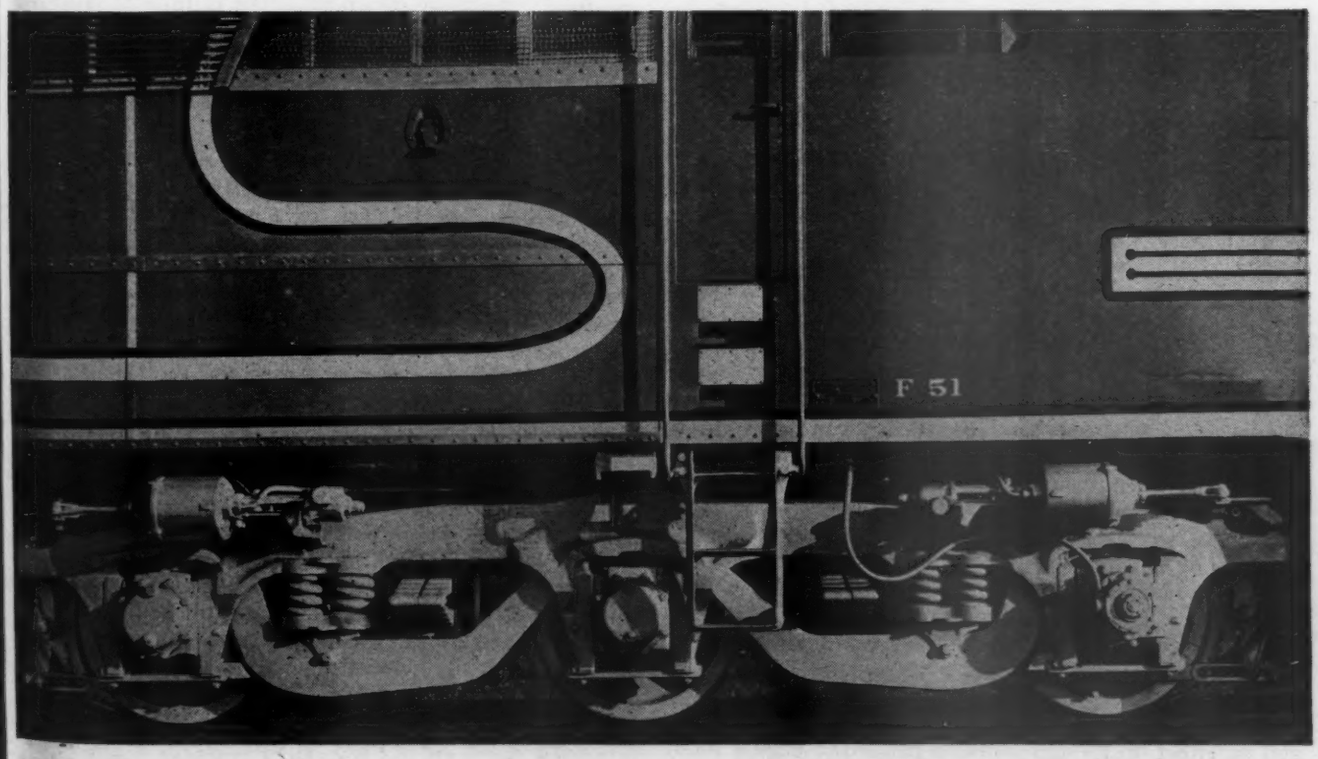
The braking resistor is built into a hatch section of the engine-room roof and located directly above the engine. The resistor consists of two banks of resistor frames at either end of a double-fan motor blower unit.

Each resistor frame is constructed of fiber material taking the form of a large honeycomb frame approximately 20 in. square by 4 in. wide and housing within it several convolutions of ribbon type resistor element. Several of these resistor units are located at either end of the blower as honeycomb frames are assembled in a behive so that the cooling air is blown through them in series.

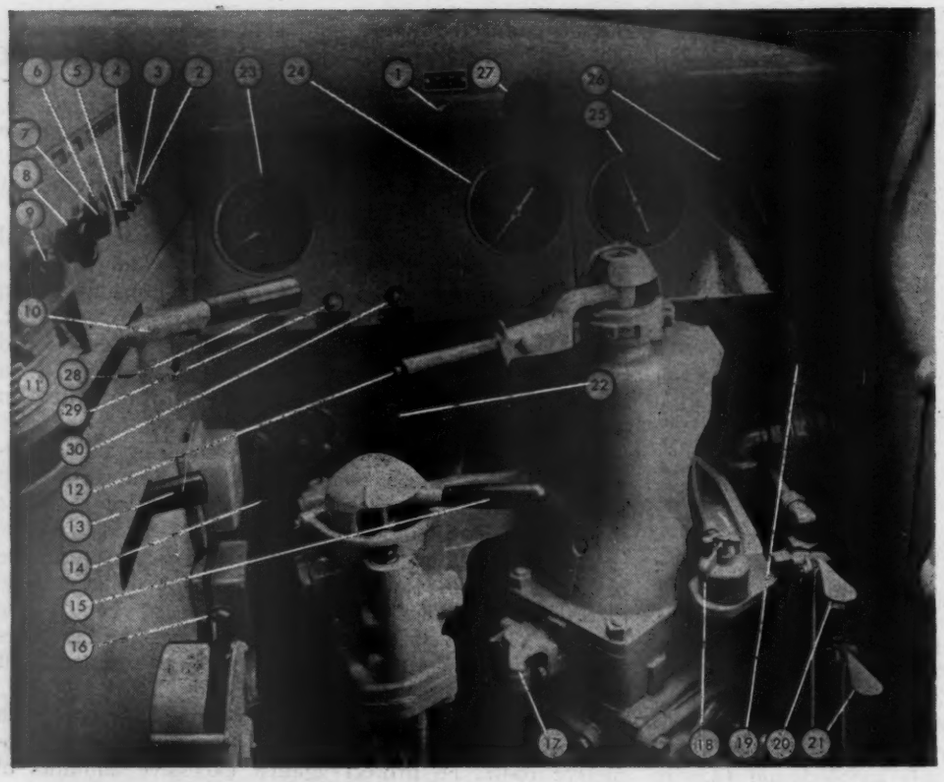
The blower unit consists of a specially designed double-shaft-extension motor with an axial flow type fan mounted directly on each end. The power leads of this motor are connected across a portion of the load resistor so that the voltage imposed upon it and, therefore, the blower speed and amount of cooling air delivered are directly proportional to the load being applied to the resistor. Its functioning is, therefore, automatic and its performance inherently proportioned to requirements but without the use of any control devices.

At either end of the resistor housing an elbow with turning vanes directs the heated air out through the locomotive roof. To protect against excessive amounts of rain, snow, or cinders falling into these air outlets when the electric brake is not in use, the roof openings are provided with vane type shutters. These are opened by the pressure of the cooling air and closed by gravity.

In addition to the use of this resistor for dynamic braking load, it is now being used also as a loading resistor for breaking in an overhauled engine. In this case by means of a few simple special connections in the power circuits the traction generator instead of the traction motors is connected across the resistor. Once the connections are made the engine may be throttled up as in



The six-wheel motor truck



1—Order light switch
2—Train control
3—Fuel pumps
4—Generator field
5—Control
6—Stop button
7—Rheostat-defroster
8—Gauge light rheostat
9—Rheostat-heater
10—Controller
11—Headlight switch
12—DS-24 Brake valve
13—Reverse handle
14—Rotair valve
15—Independent brake valve
16—Switch, Mars light
17—Selector cock
18—Bell ringer
19—Sander valve
20—Air horn, front
21—Air horn, back
22—Train-control whistle
23—Load meter
24—Train control air gauge
25—5-in. air gauge
26—5-in. air gauge
27—Order light
28—Electric brake warning
29—Wheel slip
30—Locomotive overspeed

The engineman's station

normal locomotive operation but the entire output of the generator is dissipated through the resistor. Full loading of a 2,000-hp. unit is permissible on this equipment.

The new panel type radiator, mounted in an overhead compartment, on each side of the locomotive, is unusually simple. One panel type radiator replaced 18 of the original sectional type radiators. The result is a considerable saving in weight, and the radiators can be removed or applied from the side opening by first removing the shutters.

Cooling System

The introduction of a heat exchanger for cooling lubricating oil permits the radiators to be used for cooling water only and eliminates high pressure in the radiator system. It also gives better control of lubricating-oil temperature in cold weather, as the sectional-type, air-blown lubricating-oil cooler offers many problems in winter when the lubricating oil is at a low temperature.

A single radiator fan is driven through a right-angle gear box and an eddy-current clutch. The eddy-current clutch is located between the gear box and the Diesel engine drive-shaft coupling. This makes a simple and rugged combination for the fan drive. The eddy-current clutch provides a damper in the drive system against shocks or vibrations and permits a modulated fan-speed control that has not been equalled, even with direct motor drive.

The fan-speed control and thermostat-actuated control of the Kysor shutters are synchronized so that when the shutters are closed, the fan speed is automatically cut off. When desired, the fan can be stopped entirely and independently of the Diesel engine. This method reduces the temperature control to a single variable—the temperature of the jacket water. The shutters can be closed manually to protect the cooling system in standby periods.

Careful study was made of engine-room ventilation, and its effect on the temperature inside the engine room with the Diesel engine operating at full speed. All of the air entering the cab was filtered. The arrangement of the filters is simple and the Farr filter panels can be removed for cleaning in a very few minutes. If necessary, in winter operation deflectors can be applied inside the engine room to the filter housing.

Generator ventilating air is blown out of the cab partly through the floor and partly through a duct leading to the roof. This eliminates a large amount of heat formerly released in the engine room. Dampers are provided in the exhaust ducts so that this warm air can be recirculated in the engine compartment during cold weather. Normally, when all of the equipment is in use, air inside the compartment is changed several times a minute.

Underframe and Superstructure

The underframe is a steel-plate structure, fabricated by means of electric welding. The truck center plates are cast steel welded to the underframe and equipped with hardened-steel liners. Each end of each unit is equipped with American Steel Foundries Type E couplers and National Type M-380 rubber draft gear. The couplers are housed in a cast-steel pocket and the uncoupling device is operated from the side. The uncoupling device at the front end is concealed.

The cab side frames are trusses and the cab structure and bulkheads are of welded steel construction. The side walls of the engine compartment are of Haskelite panels resting in rubber and mounted on the frame by the use of metal battens.

The nose compartment of the A unit is a strong welded steel structure within which is housed the front-truck motor blower and air-brake equipment. The operating cab at the front end of this unit has the floor elevated above the floor level of the engine compartment and the walls and roof of the operating compartment are lined and insulated. The operating compartment is fitted with two upholstered adjustable seats.

The front cab windows are fixed sash and the side windows of the operating compartment are the combination type with controlled drop sections and pivoted fro

sections. Both front cab windows are equipped with windshield wipers, defrosters and sun visors. All windows are fitted with safety glass and the fixed sash are rubber mounted in metal frames.

Exterior doors are installed at each side of the operating compartment and at each side of the engine compartment. The former have drop sash and the latter fixed sash. All exterior doors may be locked from the inside.

The engine room is ventilated with filter equipped openings in the side walls.

The passageway between units is fitted with standard vestibule diaphragm and is equipped with lighting on the engine-room circuit.

Trucks

Each unit has two six-wheel swivel, swing-motion, pedestal-type motor trucks. The General Steel Castings truck frames are spring-supported on two equalizers at each side with triple coil springs between frame and equalizers. Double elliptic springs are used between spring planks and bolsters. The center plates are equipped with safety locks. The rolled-steel wheels are 40-in. in diameter and the axles operate in Timken roller bearings. The end axles of each truck are driving axles with axle-supported motors having spring nose suspension from the truck transom. The wheel and axle assemblies are removable with the motors. Motor ventilation from the blowers in the cab is accomplished by flexible connections. Hardened liners are used on pedestal jaws and center plates. Plain steel side bearings with swivel limiting devices are used.

The traction-motor gearing may be varied for maximum speeds of from 90 to 100 m.p.h. With a 62:21 gear-pinion ratio the maximum speed is 90 m.p.h. With this gear ratio, the continuous tractive force rating is 30,500 lb. per unit. The 117 m.p.h. maximum speed is attained with a 58:25 gear-pinion ratio and the continuous tractive force with that gear ratio is 24,000 lb. per unit.

The trucks are equipped with clasp brakes on all wheels. There are two brake shoes per wheel and the braking system is operated by four 11-in. by 10-in. brake cylinders on each truck. A hand brake, connected to one truck, is operated from the engine compartment.

Engineman's Station

At the engineman's position on the right side of the cab there is located: throttle, reverser and selector handles; circuit-breaker type switches for generator field, fuel-transfer-pump control circuit, and train control; classification, gauge and headlight switches; windshield wiper and defroster controls; signal lights for high engine-water temperatures, low lubricating-oil pressure, boiler flame cut out and train control. Other controls are for air brake, whistle, bell ringer and sanders. The gauge panel contains speedometer, load meter, air gauges, signal lights for wheel slip, engine overspeed and dynamic brake warning. On the left side of the cab are controls for cab heater, defroster and wiper and dashlight.

In the engine room is a control panel on the cab wall containing switches for engine starting and control, radiator fan control, fuel transfer pump and panel light, engine tachometer and gauges for fuel and oil pressure, intake manifold air pressure, lubricating-oil pressure to supercharger; engine-water temperature indicator; signal lights for high engine-water temperature; low lubricating-oil pressure ground relay, traction-motor blowers, crank case exhauster and boiler flame cutout. This control panel also contains a group of control relays and pressure and temperature control switches. Adjacent to the panel is the battery disconnecting switch.

A single fuel tank of 1,200 gal. capacity is located beneath the cab, between the trucks. There are two filling connections and two vents, fire-protection screens, fuel-level indicators and emergency cut-out valves controlled by handles near the filling connections. Provision is made for cleaning and draining the fuel-oil tank.

There is a 90-gal. engine-water tank built integral with the engine hatch cover with filling connections on the right side of the locomotive and on the roof.

Steam for train heating is supplied by a Vapor-Clarkson steam generator located at the rear end of the engine compartment of each unit, having a capacity of 3,000 lb. of steam per hour at 225 to 275 lb. pressure. Water tanks of 1,000 gal. capacity are located at the sides of the engine compartment with filling connections to the outside. The water tanks are supplied with level indicators.

The brake schedule is Westinghouse 24-RL with automatic and straight air brakes on all wheels. The deadman safety control is operated by a foot pedal. Air for the brake system is supplied by one two-stage, three-cylinder, air-cooled compressor, having 306 cu. ft. per min. capacity at full engine speed, direct driven from the main engine through flexible couplings. The compressor is equipped with an intercooler and aftercoolers between both the compressor and first main reservoir and first and second main reservoirs. These reservoirs, suspended beneath the underframe, have a combined capacity of 35,770 cu. in. U. S. S. train-control equipment is installed.

Other locomotive equipment consists of warning signals, Co-Two fire extinguishers, sanders with control incorporated in the automatic brake valve and arranged for electric multiple-unit operation, and sanitary fixtures at the rear end of the engine compartment. The headlights are Pyle-National and they are associated with Mars signal lights.

I. C. Aluminum Refrigerator

(*Continued from page 648*)

one on each side of the car to give top and bottom inside temperature readings.

The Preco air-circulating fans under the floor rack at each end of the car are normally driven by V-belt connection to a rubber-tired wheel which rides on one of the car-wheel treads on each truck. This drive may be readily disengaged and outside V-belt drive from a portable electric motor to an auxiliary pulley on the fan shaft substituted to permit rapid precooling while the car is being loaded.

The A-3 Ride-Control trucks are equipped with 33-in. wrought-steel wheels and Pittsburgh hollow axles with 5-in. by 9-in. plain journals. The side frames are mated in accordance with the latest A.A.R. instructions to maintain the distance between journal centers on each truck within desired limits. Other special equipment used on the trucks are shown in one of the tables.

Considerable delay was experienced in constructing this car due to material shortages caused principally by strikes. There was also some delay due to the shortage of draftsmen to make drawings for the 3,385 parts going into the car. The material was finally completed and the last parts arrived at McComb shops the first week of August, 1946. Assembly of the car was begun August 12 and it was completed in the latter part of September. It has since been subjected to extensive controlled service tests and much pertinent performance data collected ready for analysis.

The Norfolk & Western's Use of

Modern Steam Locomotives*

By C. E. Pond†

SINCE 1936 the Norfolk & Western has designed and constructed 116 modern steam locomotives in its Roanoke, Va., shops. These locomotives are essentially of three types: (1) a streamlined 4-8-4 passenger locomotive, Class J; (2) a single-expansion 2-6-6-4 articulated freight and heavy passenger locomotive, Class A, and (3) a 2-8-8-2 compound Mallet heavy freight locomotive, Class Y5, Y6, Y6a.

In designing these locomotives, the objective was to develop a steam motive power unit that would have sufficient hauling capacity to handle trains over mountain grades; that would be capable of reasonably high speeds where operating conditions were favorable; that would be capable of making long runs with a minimum of attention and that would perform this work at a lower maintenance cost than has been acceptable for steam motive power of conventional design.

The Class J Passenger Locomotive

The boiler of the Class J locomotive[1] is of the conical, radial-stay type. The firebox is 146 in. long by 106¼ in. wide, and is of completely welded construction. All sheets used in the construction of the boiler are of carbon steel. The length of the combustion chamber is 103¼ in. The boiler has 227 superheater flues, Type E superheater, and American multiple-valve front-end throttle built into the header.

Coal is fed by a Standard HT stoker, and the firebox is fitted with grates having an air opening of 35 per cent. Water is supplied by a Nathan Type 4000 injector and a Worthington 6SA feedwater heater, each having a capacity of 12,000 gallons per hour.

The boiler was designed for a working pressure of 300 lb., but the pressure was set at 275 lb. when the locomotives were constructed. The tractive force on this basis was 73,300 lb., and the factor of adhesion 3.9. During a series of dynamometer-car tests las summer, the boiler pressure was raised to 300 lb., which gave a tractive force of 80,000 lb., and a reduction in the factor of adhesion to 3.6. The locomotive performance was so much better at the higher boiler pressure and the tendency for the driving wheels to slip was not discernibly increased, that the boiler pressure on all 11 Class J locomotives was increased to 300 lb.

The weight of the revolving parts is 2,747 lb. The overbalance is 175 lb. for the front, intermediate and back wheels, and 25 lb. for the main wheels. The dynamic augment at 70 m.p.h. is 9,061 lb. for the front, intermediate and back wheels, and 1,284 lb. for the main wheels. All driving wheels are cross balanced. A speed of 140 m.p.h. would be required in order that the dynamic augment could equal the static wheel load of 36,000 lb.

The maximum recorded speed of one of these locomotives is 110 m.p.h., handling a 15-car 1,025-ton train on level tangent track. This locomotive had tires worn to 68½ in. outside diameter. The average piston speed under these conditions was 2,878 ft. per min. and the driving-wheel speed 540 r.p.m.

The piston, piston rod, crosshead, side and main rod assembly are of Timken light-weight design. All the main and side rods, which had an average yield point of 127,480 lb., were manufactured in Roanoke Shops.

The first five of these locomotives have multiple-bearing crossheads, and the last six have alligator type crossheads. Both have aluminum crosshead shoes.

The No. 2 driving wheel is the main, and tandem intermediate rods couple the main and intermediate wheels.

Location of Roller Bearings and Service Results—Class J Locomotives

Position	Number roller bearings on each locomotive	Total number engine failures resulting from roller bearing failures, 11 Class J locos.
Engine trucks	4	0
Drivers	8	0
Trailer trucks	4	0
Tender trucks	12	0
Wrist pins	2	0
Crank pins	8	2
Valve Gear	28	0
Total	66	2
Total mileage accumulated by 11 Class J locomotives since built (Oct. 1941 through March, 1946)		5,228,295
Average mileage per roller-bearing engine failure		2,614,148

Single rods couple the front and rear wheels to the main and intermediate.

The Class J locomotive is the first N. & W. locomotive to be fitted with roller barings on the crosshead and crank pins.

Considerable attention was given to the method of lubrication. Every locomotive part in which friction is a factor was studied with the idea of using either anti-frction bearings or improved methods of lubricating the friction bearings. These locomotives are equipped with mechanical lubricators, having auxiliary oil reservoirs, so that the total engine oil capacity is 28 gallons, and the total valve oil capacity is 22 gallons, or, sufficient oil for a run of 1,300 mi. The mechanical lubricators supply 220 different points. In addition, 72 points are lubricated with fittings for pressure grease lubrication.

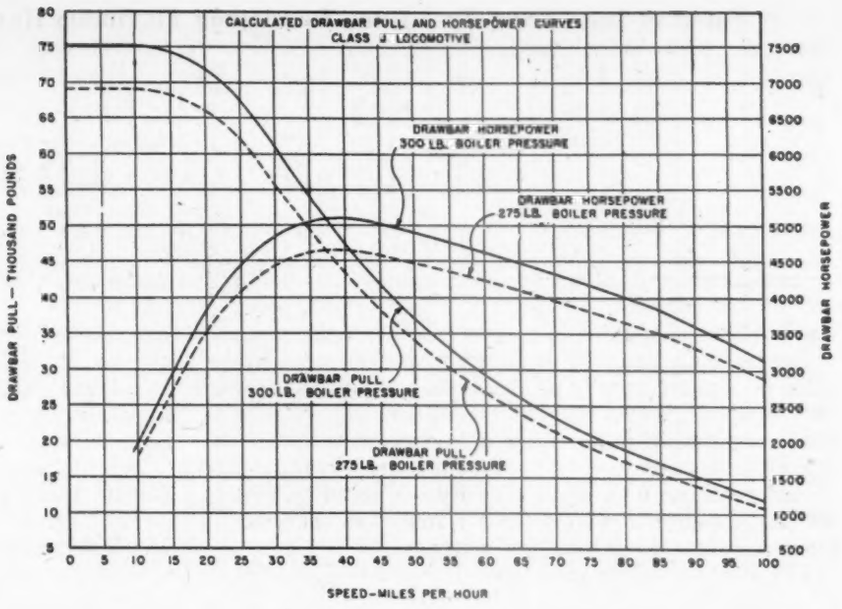
Steam distribution is controlled by Baker valve gear, having a maximum valve travel of 8½ in., with a cut-off in full gear of 82 per cent. Piston valves 14 in. in diameter are used.

In speaking of modern locomotives, the words "availability" and "utilization" have been greatly emphasized. Availability is generally considered the responsibility of the locomotive designer and builder. The definition of availability differs widely and is influenced by train schedules, demand for power, and the availability of crews.

We are interested, to a larger degree, in the actual utilization of the locomotive. Utilization is the responsibility of the mechanical and operating departments of a railroad. The Class J locomotives are actually utilized 60 per cent of the time, and average 15,000 miles per locomotive per month. On a longer, higher-speed rail-

* Abstract of a paper presented at the Southern & Southwestern Railway Club, Atlanta, Ga., May 16, 1946. The motion picture "The Modern Steam Locomotive" was shown in conjunction with the presentation of Mr. Pond's paper.

† Assistant superintendent motive power, Norfolk & Western.

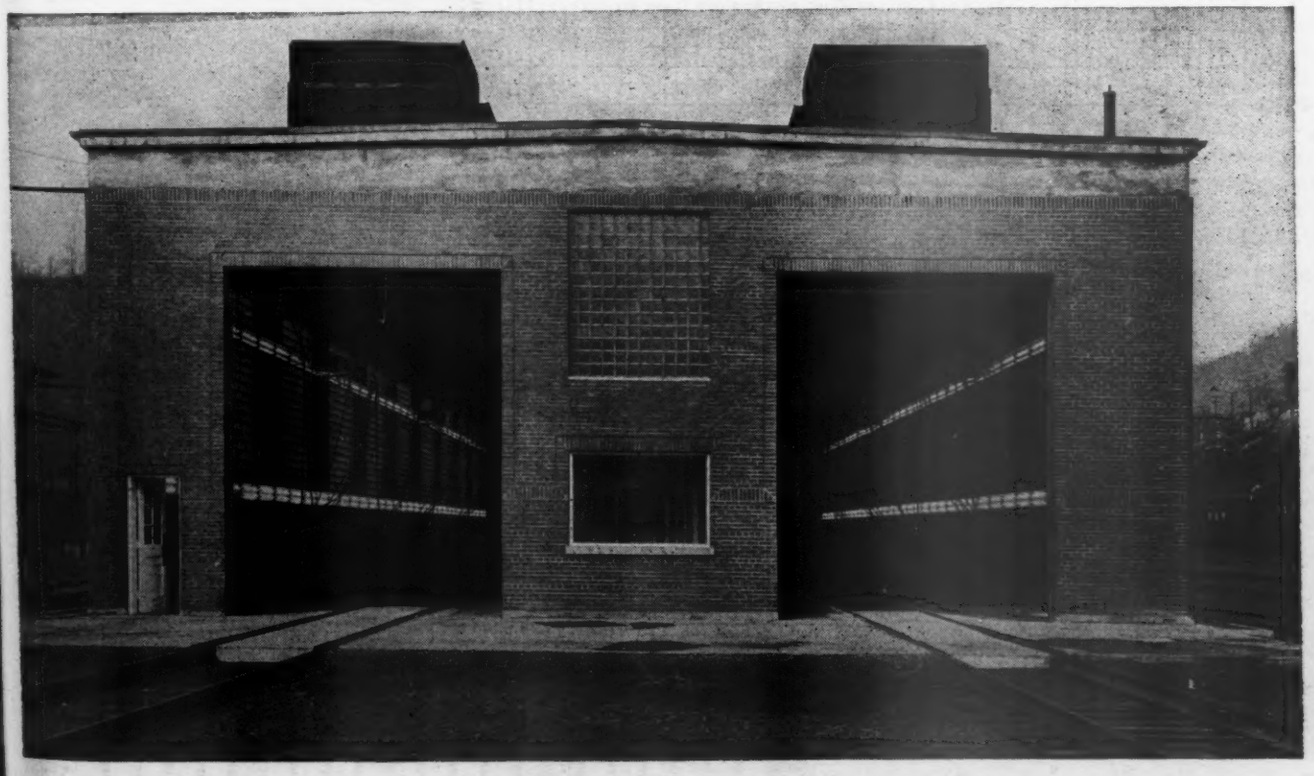


Comparative drawbar-pull-speed chart for the Class J locomotives showing the influence of the change in boiler pressure

road, where the locomotive can be assigned to extended passenger runs, mileages greatly in excess of 15,000 per month could be made.

Last summer the Class J locomotive was subjected to extensive dynamometer tests on the Radford Division to determine the maximum horsepower and general locomotive performance under given loads and speeds. The section of the Radford Division selected for the tests was that between Roanoke and Christiansburg, Virginia, a distance of around 38 miles. The data relating to maximum performance was obtained in the 12 miles of this section between Elliston and Christiansburg, in which distance the ralroad crosses one range of the Allegheny Mountains with an almost uniform ascending grade of 1.3 per cent.

In planning and preparing for the tests, provision was made for obtaining data as regards pressure, temperatures, coal used, water used, speed, drawbar pull, etc., with variables held to a minimum. A special train was used, and for a given tonnage the train was made up of the same cars. The base train of 1,065.4 tons was made up of 15 passenger coaches and the dynamometer car. When heavier trains were desired, loaded coal cars were added. The locomotive was operated by the same engine crew for all test runs. Starts and stops were made at the same locations with no interference during the run. A level device was used to obtain approximately the same water in the boiler at start and stop. The coal was weighed as used. The weight of tank water used was obtained by measurements on a calibrated tender cistern and feed-water heater recovery developed on the basis of temperature and pressure of exhaust steam and temperature of feed water delivered to the boiler. All coal used



Williamson, W. Va., service building

Selected Data from Test Runs Developing Maximum Horsepower—Class J Locomotive

Run No.	Speed m.p.h.	Cutting off per cent	Train (tons)	Water Evaporated lb. per hr.	Dry coal fired lb. per hr.	Firing rate lb. per hr.	Pressure, lb. Boiler	Pressure, lb. Steam chest	Pressure, lb. Exhaust passage	Steam chest temp. deg. F.	Avg. Drawbar hp.
					275-lb. Boiler Pressure						
23	39.15	66	1,065	104,946	15,145	141	270	238	19.9	665	4,795
25	39.07	66	1,065	103,860	13,646	145	274	243	20.6	701	4,784
					300-lb. Boiler Pressure						
24	39.14	61	1,065	103,365	14,828	138	287	253	19.0	676	4,806
26	41.03	60	1,065	99,942	13,068	121	295	268	20.2	697	5,028

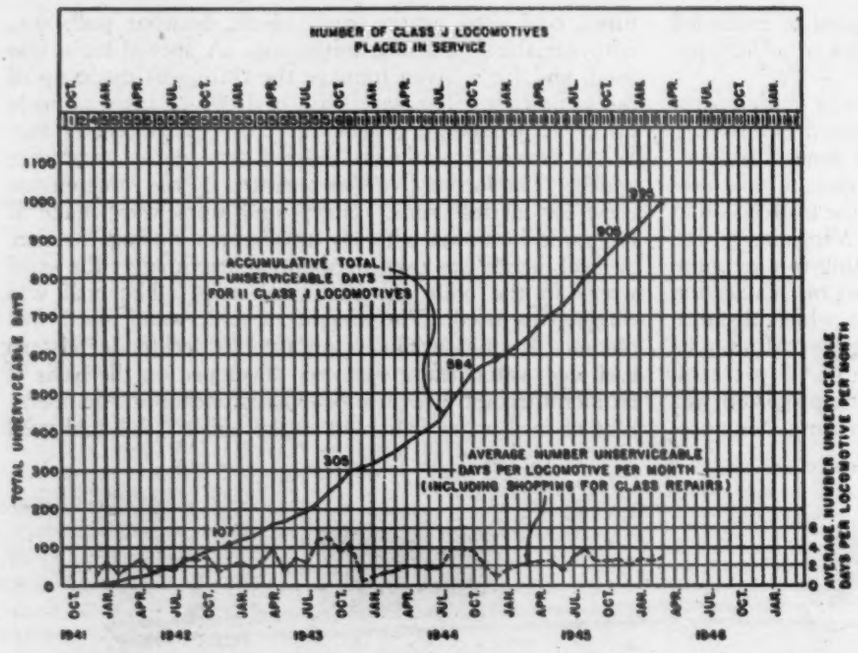
was of the same nominal size, and from the same mine.

During these tests the locomotive was operated to develop maximum capacity using 275 lb. boiler pressure with each of the different tonnage trains handled. This was also true using 300 lb. boiler pressure, except with the 1,065.4 tons where speed limit on curves to 40 m.p.h. prevented reaching maximum capacity. The advantage of 300 lb. pressure handling 1,065.4 tons was reflected in improved economy in coal and water.

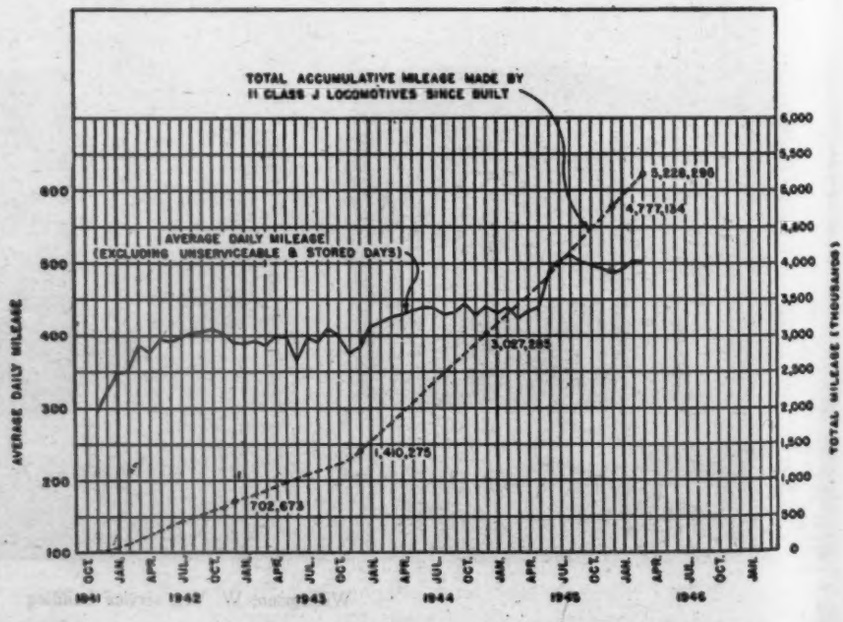
The accuracy of the calculated drawbar pull and drawbar horsepower curves in the lower speed range was checked in the Elliston to Christiansburg district. A drawbar horse power equal to approximately 5,100 at 40 m.p.h. was accurately established in these tests. Corrections were made for observations taken on grade.

Selected data from tests developing maximum horsepower at 275 and 300 lb. boiler pressure are tabulated.

The accumulated maintenance cost (charged to ME-308), including class repairs, on the Class J locomotive for 4⅓ years is $13.34 per 100 locomotive miles.



Record of unserviceable days of the N. & W. Class J locomotives for over four years of operation related to the number of units in service



Mileage record of the N. & W. Class J 4-8-4 type passenger locomotives, showing both the average daily mileage and the total for the entire period of service

Interior of the servicing building at Williamson, W. Va.

Class A Articulated Locomotive

The Class A is a single-expansion articulated locomotive[2] with a 2-6-6-4 wheel arangement, and is used for freight and heavy passenger service. These locomotives have a high-capacity boiler, are equipped with cast-steel beds, roller bearings on the engine trucks, drivers, trailing trucks, and tender trucks, and have mechanical lubrication to a total of 238 points. In addition, 98 points are lubricated by pressure fittings.

The maximum sustained drawbar horsepower as determined by dynamometer records is 6,300 at 45 m.p.h. The maximum rate of evaporation recorded is 116,055 lb. of water per hour, or approximately 14,000 gallons; maximum sustained combustion rate seven tons an hour.

The accumulated maintenance cost (charged to ME-308), including class repairs, for the Class A locomotive is $21.12 per 100 locomotive miles.

Compound Mallet Locomotives

The type 2-8-8-2 compound Mallet locomotive, Classes Y5, Y6, Y6a, have a calculated tractive force of 126,000 lb. compound, and 152,000 lb. simple. Seventy of these locomotives are in service. Weights, principal proportions, and general dimensions of the Class Y6 locomotive are shown in an accompanying table. These locomotives are equipped with cast-steel beds, roller bearings on the engine trucks, drivers and trailing trucks, and have mechanical lubrication to a total of 213 points.

This type of locomotive is assigned to both time and slow freight service in mountainous teritory. Where operating conditions permit, the attain top speeds of 45 to 50 miles per hour with tonnage trains.

The total accumulated maintenance cost (charged to ME-308), including class repairs, is $23.76 per 100 locomotive miles.

Engine Terminal Improvement

One of the factors largely responsible for the increased road locomotive utilization is the improvement made in engine terminals, so that incoming locomotives can be rapidly serviced and made available for quick dispatchment on the same or another train, in either the same or opposite direction. Modern terminal facilities have been provided at Shaffers Crossing,[3] (Roanoke) Va. and we have just modernized the facilities for servicing locomotives at Williamson, W. Va., and placed them in service. These are more elaborate and more condensed than the facilities at Shaffers Crossing. The new facilities consist of two major units. (1) a new three-track concrete engine washing platform, combined with hydraulic ash-handling facilities, which will serve six tracks, and four standpipes with the necessary piping. Here the locomotives have the fires cleaned, are washed, the tenders filled with water, boiler water tested, and the boilers blown down if required. All of these operations can be done with one spotting of the locomotive; (2) a new twin-track engine service building with two inspection pits 135 ft. in length. In this building the locomotives are inspected, lubricated, given minor running repairs, and prepared for dispatchment. The majority of locomotives

[2] A complete description of the 2-6-6-4, Class A, locomotives appeared in the *Railway Mechanical Engineer* for October, 1936, page 421.

[3] An article describing the Shaffers Crossing engine terminal facilities appeared in *Railway Mechanical Engineer* for March, 1944, page 103.

General Characteristics of Norfolk & Western Class Y-6 Locomotives

Weight in Working Order, lb.:	
On drivers	522,850
Engine truck	32,200
Trailing truck	27,850
Engine total	582,900
Tender	378,600
Engine and tender	961,500
Light weight tender	135,200
Boiler pressure, lb.	300
Tractive force (compound) lb.	126,838
Tractive force (simple) lb.	152,206
Grate area, sq. ft.	106.2
Factor of adhesion (compound)	4.12
Factor of adhesion (simple)	3.44
Total engine wheel base, ft.-in.	58-0
Total engine and tender wheel base, ft.-in.	103- 8¼
Total length, engine and tender, ft.-in.	114-10½
Heating surface, sq. ft.:	
Flues	5,217
Firebox	371
Arch tubes	59
Superheater	1,775
Total	7,422
Tender capacity:	
Coal, tons	30
Water, gal.	22,000

will be given routine handling in this building, and will enter the roundhouse only for periodic inspections.

Track changes were also made to provide a flexible arrangement.

In providing these changes, it was found that an old 21-stall roundhouse with a 100-foot turntable, four bucket-type ash hoists, four outdoor engine inspection pits, and other allied facilities could be retired.

The total cost of the Williamson project was approximately $300,000.

If modern steam power is to be used economically, there must be modern facilities for servicing.

Modern steam locomotives can be utilized a greater per cent of the time than conventional locomotives. The total number of passenger locomotives owned by the Norfolk & Western is 81 and of these, 11, or 14 per cent are of modern design. This 14 per cent handle 50 per cent of the total passenger car miles.

The total number of steam freight locomotives owned is 339 and of this number, 105, or 31 per cent, are of modern design. This 31 per cent of the steam freight locomotives handle 69 per cent of our through freight gross ton miles, and 59 per cent of the gross ton miles of all freight trains.

N. & W. Not "Allergic" to Diesel Power

The Norfolk & Western is not "allergic" to Diesel power plants. We own and operate some Diesel equipment, such as a bunkering barge for refueling ships, and work equipment consisting of bulldozers, shovels, and locomotive cranes. We have an order placed for a 250-ton Diesel wrecking crane.

Under certain conditions, Diesel locomotives cen be utilized to advantage. For instance, in traversing desert country where water conditions are extremely bad, the Diesel locomotive works out very well. In other cases, where the strength of the bridges and track structure have to be taken into consideration, the wheel loads of the modern steam locomotive cannot be sustained. Again, the Diesel locomotive with a multiplicity of driving wheels works out well. For certain yard switching operations, where it can be used around the clock, and the cost of coal is excessive, the Diesel can be used to advantage.

The Norfolk & Western serves the bituminous coal fields of southern West Virginia and southwestern Virginia which produce a great volume of coal. In the year 1945 we handled a total of 47,600,000 net tons of coal other than our own fuel. Naturally, we are interested in the welfare of the coal business. It is our belief that the conventional type of coal-burning steam locomotive can be greatly improved and made at least the equal in efficiency and economy of operation, under most conditions, of any other type of railroad locomotive. Our experience with the operation of the types of locomotive I have just described further confirm us in this view.

Discussion

Q.—What is the average cost per 100 locomotive miles for all classes of steam power owned? A.—Mr. Pond: 51 cents per locomotive mile for the year 1945.

Q.—What is your availability percentage? A.—Mr. Pond: It is about 75 per cent for the 4-8-4. We consider utilization more important than availability, and the locomotives are actually utilized approximately 60 per cent of the tme. We could improve the utilization if we had a longer high-speed railroad.

Q.—On these long runs where you stop to change crews, is it necessary to clean the fire? A.—Mr. Pond: In normal times when we receive a satisfactory fuel coal, it is not. At the present time it is necessary to clean fires when we change crews as the fuel coal is of inferior quality.

Q.—What class of front end to you use? A.—Mr. Pond: We use the Master Mechanic's front end.

Q.—Don't you use double screened coal on your railroad? A.—Mr. Pond: In normal times about 25 per cent of the coal used is double screened. At the present time we are using any grade that can be supplied.

Q.—What is the mileage between set-back repairs? A.—Mr. Pond: The 4-8-4 locomotive is averaging approximately 260,000 miles between Class 3 repairs. We shop the 4-8-4's for Class 5 repairs between the Class 3 repairs.

Q.—Do you remove any flues on the Class 5 repairs? A.—Mr. Pond: A few in the top section of the flue sheet.

Q.—Do you always renew flues? A.—Mr. Pond: On Class 3 repairs we renew all flues. On Class 5 repairs we renew flues as required.

Q.—What is the percentage of broken staybolts? A.—Mr. Pond: The average number of broken staybolts per year per locomotive is about three.

Q.—What type of staybolts do you use? A.—Mr. Pond: We use iron staybolts.

Q.—You say that the average number of staybolts broken per locomotive per year is about three. Do you make tensile strength tests of your bolts? A.—Mr. Pond: Staybolt iron is purchased according to a specification, and the material is checked in our own laboratory to see if it meets specifications.

Q.—What increase in horsepower did you secure when the boiler pressure was raised from 275 to 300 lb.? A.—Mr. Pond: On the 4-8-4 locomotives, when the boiler pressure was increased from 275 to 300 lb., the horsepower was likewise increased approximately 10 per cent.

Q.—Do you use nickel or any other type steel for locomotive boilers? A.—Mr. Pond: Some years ago we constructed a group of locomotives with nickel-steel boilers. We did not secure as good results with the nickel steel as with plain carbon steel. All recent locomotives constructed for the N. & W. have plain carbon-steel sheets in the boilers.

Q.—You have about 35 per cent air opening in the grates? A.—Mr. Pond: That is right.

Q.—Do you get 125,000 miles between tire turnings? A.—Mr. Pond: On the modern 4-8-4 locomotives we do get from 125,000 to 130,000 miles between tire turnings. On the modern 2-6-6-4 locomotives we average between 75,000 and 80,000 miles between tire turnings. On the heavy compound 2-8-8-2's we get from 75,000 to 80,000 miles between tire turnings. Prior to the introduction of the modern steam locomotive we could only get from 50,000 to 60,000 miles per tire turning.

Q.—To what do you attribute your exceptional mileage? A.—Mr. Pond: The only explanation I can give is that these locomotives are equipped with roller bearings, cast-steel beds, and extended mechanical lubrication. The accuracy of wheel alignment is assured by roller bearings and one-piece bed frame. These locomotives are properly counterbalanced and have extended mchanical lubrication to all moving parts, including the spring rigging. We think these factors are responsible for the good tire mileage obtained with these locomotives.

Q.—What type of flange oilers do you use? A.—Mr. Pond: We use wayside track oilers.

Q.—On your two modern classes of power, do you prefer the multi-ledge or the alligator type crosshead? A.—Mr. Pond: We secure somewhat better mileage per crosshead lining from the multi-ledge type.

Q.—You said the cost of the modernized locomotive servicing facilities at Williamson was about $300,000. Do you think the saving will warrant that expenditure? A.—Mr. Pond: While it only has been in service a short time, we consider the expenditure was warranted.

New Shops Maintain

Burlington Diesel Power

Partial interior of the Burlington's new Diesel shop at Denver, Colo.

WITH a growing fleet of Diesel motive power which now includes about 170 road and switching locomotives, the Chicago, Burlington & Quincy started some time ago and has recently completed three new Diesel shops, including light, or running maintenance, shops at Clyde, Ill., and Denver, Col., and a heavy repair shop at West Burlington, Iowa. The shop at Denver is entirely new, that at Clyde includes a new building supplemented by a portion of an existing enginehouse and machine shop, while at West Burlington part of an existing steam locomotive erecting shop was taken over and remodeled for Diesel work.

The Burlington already had an assigned track, drop table and other facilities at Fourteenth street, Chicago, where passenger road Diesels were maintained and this power is now being given running repairs both at Fourteenth street and at the new shop in Denver. Running maintenance on all Diesel road freight locomotives is handled at Clyde and Denver. Diesel switchers, working in territories adjacent to these shops, are currently maintained in the nearest shop and heavy repairs are now given to all classes of Diesel power at West Burlington.

Clyde Diesel Locomotive Shop

The Diesel locomotive shop at Clyde, Ill., just outside of Chicago, is the principal maintenance point for eleven 5,400-hp. and ten 4,050-hp. Diesel freight locomotives and 20 Diesel switchers of 600- and 1,000-hp. rating. The freight Diesels are Electro-Motive type and the switchers are Electro-Motive, Alco and Baldwin types, necessitating the storage and handling of a large number of different locomotive parts and the provision of a wide range of facilities for making repairs.

The new shop building is 80 ft. wide by 325 ft. long and has a 30-ft. by 130-ft. wing used as a locker and washroom and an integral 18-ft. by 62-ft. one-story filter building along one side. The end of the shop adjacent to the enginehouse is entirely open, so that, in effect, the shop as a whole is 515 ft. long.

The shop is served by two through tracks which, with a third track taken over in the enginehouse makes it possible to handle five 5,400-hp. freight Diesels in the shop at one time. These four-unit locomotives are usually brought into and taken out of the shop from the west end where new sanding and fueling facilities are located on the lead-in tracks.

The main shop includes two service tracks with inspection pits and, in what has come to be accepted general practice in Diesel shops, two-level working areas. Other facilities include truck and wheel storage tracks, a Whiting drop table, electric and air brake repair rooms, machine shop and pipe rooms, small parts storage room, bulky unit storage space, 30-ton overhead crane, office, supply lines for lubricating oil, hot water, steam and compressed air, also light, power and heating facilities.

The inspection pits, 293 ft. long and continuous except for the 23-ft. drop-pit opening, are three feet deep east of the drop pit, but four feet deep west of the pit to give headroom for movement through them of a Wilson deicing machine. This machine can be readily moved from one pit to the other by the shop crane. It consists of a large radiator unit, heated by steam from a high-pressure supply line, a motor-driven fan and a grill of adjustable vanes which direct a stream of heated air upward towards the lower parts of locomotives and melt off snow and ice.

The Whiting 80-ton drop table serves the two through service tracks, also two 54-ft. truck and wheel storage tracks and two 40-ft. release tracks. The wheel storage tracks are at the depressed floor level, and the release tracks at the upper level extend in the opposite direction into the old enginehouse machine shop. Whiting locomotive body supports on each side of both service tracks at the drop pit are applied under the locomotive units while the trucks are being removed and replaced. The Whiting 30-ton overhead crane operates the entire length of the new building.

Adjacent to the well-equipped air brake room is the 17-ft. by 61-ft. machine shop where the Diesel engine

cylinder heads, liners, pistons, valves, governors and other engine parts are reconditioned. This room is supplied with numerous power tools and other repair facilities, including an Independent-Pneumatic cylinder-liner glaze remover, valve grinder, 60-ton arbor press, Woodward governor test rack, Sibley 22-in. upright drill, 16-in. lathe, bench drill and black-light crack-testing apparatus, etc.

The 17-ft. by 17-ft. electrical shops are supplied with all electric inspection and repair facilities required for running maintenance work on Diesel locomotives. Since all filters on the road's freight Diesels are cleaned and oil-freshened at the Clyde shop, except in the case of Diesels sent to West Burlington for heavy general repair, the facilities provided in the filter building are quite comprehensive, including a 250-lb. P. & H. monorail electric hoist mounted over four vats for removing oils and grease, rinsing, air blowing and drying, and dipping for the application of a clean oil film. This hoist also serves an oil drain board and a bake oven. For the cleaning of engine cylinder heads, pistons and small parts, the filter building is also equipped with two large lye vats, with a water-rinsing grill between them, which are served by a ½-ton P. & H. electric hoist. The basement contains a small room for the maintenance of batteries and a room for the storage of locomotive parts.

The shop interior is painted to the color-dynamics plan of the Pittsburgh Plate Glass Company, which focuses the eye on critical objects and areas, while at the same time making the general surroundings pleasant. The colors used include red for the depressed floor and step surfaces; gray for the columns of the platforms and for the lower part of the side walls; light green for the upper side walls, roof and trusses; and yellow for the undersides and edges of the platforms. The overhead crane beams and the control cab are also painted yellow, but the block and hook are painted red. Other critical objects, such as fire-hose supports and the electric control boxes, are painted bright orange.

An oil reclamation building, about 100 ft. south of the Diesel shop, is a one-story structure 27 ft. wide by 50 ft. long, underlaid with a basement 11 ft. wider on one side to prevent crowding the facilities located there, and the roof of this extension serving as an oil barrel loading station. The basement houses three large oil-storage tanks, each of 11,500-gal. capacity which are used, respectively, for storing used, refined and new oils. It also contains necessary pressure tank, oil pumps, booster pump, oil meters, etc.

Refinoil oil-reclamation equipment and a Bowser six-tank oil-distributing system is located on the first floor of the oil house. The oil supply and drain lines, carried under the high platforms in the main shop, are connected to the oil reclamation building by lines laid in a concrete pipe tunnel, and the lubricating oil is metered as it is used, both in the shop and the reclamation building. New oil is unloaded from tank cars on an adjacent spur track.

West Burlington Diesel shop, looking towards engine assembly and test end

Denver Diesel Shop

The Denver Diesel shop of the Burlington, built at the railroad's engine terminal in that city, includes a modern running maintenance shop, two-story general service building, two washtables, a 4-track Snowco sanding station and a fueling station. The main shop building is 72-ft. wide by 265 ft. long, with an irregular extension about 50 ft. wide by 100 ft. long used as a Diesel machine shop.

The general type of construction and equipment of this shop is essentially the same as that at Clyde, except that no overhead traveling crane is provided. The shop has one through and two stub service tracks, with continuous working platforms between them but not along the side walls. Another difference from the Clyde layout is that no truck and wheel-storage tracks are provided under the platforms. Instead, trucks and wheels are stored on a track 140 ft. long, just west of and parallel with the shop, which is served by an extension of the drop pit outside the building.

The machine and other Diesel locomotive repair equipment at this shop is the equivalent of that at Clyde shop. The adjoining service building is a 2-story structure, 45 ft. by 150 ft., underlaid with a complete basement, equipped with an 8-ft. by 10-ft. platform elevator and served by a spur track along the entire east side of the building. The first floor is assigned half to the stores

department and half to a coach yard and enginehouse office, general foreman's office and engineman's registry.

There are three reinforced concrete washtables just north of the main shop, also a new 4-track Snowco sanding station and ten fueling standpipes.

West Burlington Diesel Shop

All types of Diesel motive power on the C. B. & Q. are given heavy repairs at the new shop facilities at West Burlington, Iowa, which were provided by remodeling and refitting a portion of the existing steam locomotive general repair shop at that point. The locomotive shop, as a whole, which lies in an east-west direction, covers an area 310 ft. wide and 792 ft. long and consists essentially of four bays extending the full length of the building. The largest and highest bay is the erecting shop, which is flanked on its north side by two 70-ft. machine-shop bays, separated from the erecting bay alone by longitudinal lines of columns, which are on 22-ft. centers in each line. On its south side, the erecting shop bay is flanked by another 70-ft. bay, formerly used as a dismantling shop, which, in the recent work, was walled off from the shop proper to form the new area for heavy Diesel repairs. As now operated, the locomotive shop at West Burlington handles both steam and Diesel repairs, steam repairs being handled in the erecting bay and Diesel repair operations confined to the erecting bay, as necessary, and the completely walled off south bay.

The erecting shop bay, 100 ft. wide by 52 ft. high, is served by three through tracks on 30-ft. centers, each with a continuous inspection pit 764 ft. long. These tracks are used in common by both steam and Diesel locomotives, with no particular track assigned solely to one class of power, and are served by a 250-ton overhead traveling crane, which, in so far as Diesel work is concerned, used for the removal of trucks, the setting in and out of main Diesel engines and generators and for transferring them to and from the Diesel shop bay.

No major changes were made in this bay when providing the new Diesel repair facilities.

Adaptation of the Diesel shop bay to the repair of Diesel engine units, included primarily the construction of the previously mentioned partition wall between this bay and the adjacent erecting bay; the removal of the old concrete floor and such trackage as existed in the bay; the replacement of the windows in the south side wall with large areas of glass; the construction of several brick partition walls to form five rooms, with ceilings of concrete, at a height of 14 ft.; the placing of numerous foundations to support new machinery and equipment to be installed for Diesel repair operations; the laying of a new concrete floor throughout the bay; and the installation of new heating and lighting facilities.

From a repair-operations standpoint, the Diesel shop is divided into four sections, each suitably equipped for the classes of work to be carried out in it, and an existing 15-ton overhead traveling crane provides lifting service for all sections. Starting at the west end, the first eight panels of floor area between columns are assigned to engine repairs, including inspection, dismantling, complete overhauling, repairing and testing. The adjoining seven panels are assigned as an auxiliary engine-repair section, and provide an office, a tool room and a substore area. The next 11½ panels are designated as the electrical shop, and the last 9½ panels are assigned to truck and wheel repair. No barriers of any kind separate the various sections, and all of them are served by a 12-ft. truckway which extends longitudinally throughout the center of the bay.

Clyde Diesel shop interior showing Whiting drop table and 30-ton overhead crane

New fuel and lubricating oil storage and delivery facilities have been provided, the fuel oil facilities being located immediately west of the shop and including a 20,000-gal. storage tank, a brick pumphouse 6 ft. sq., and fuel unloading and loading apparatus. The new lubricatnig oil facilities, located in this same general area, include essentially a one-story brick pumphouse, 11½ ft. by 20 ft., and an adjacent concrete barrel-receiving platform, 20 ft. by 40 ft., together with the necessary pipe lines for distribution of the oil to various using points in the shop.

Additional information regarding the West Burlington Diesel shop will appear in subsequent issues.—(Editor).

EDITORIALS

Production Welding Methods

Two significant papers on welding procedures and techniques used in the quantity production of railway rolling stock were presented before the railroad session of the American Welding Society on November 18, 1946, at Atlantic City, N. J. They were significant because they showed that welding equipment and the art of welding have been developed and are available to fit the production and economic requirements of any car-construction program.

In describing the production of railway passenger cars by resistance welding, A. M. Unger, welding engineer of the Pullman-Standard Car Manufacturing Company, presented a picture of the extensive use of automatic welding machines and welding fixtures in turning out a large volume of repetitious work. Typical of the technique and equipment employed by this company were the spot-welding of the car sides and roofs, held securely in fixtures handling complete roofs or sides as units, and the multiple-electrode machine with electronic control that automatically indexes the work under a row of spot-welding electrodes in welding subassemblies of stiffeners to the side sheets. The multiple-electrode machine with its automatic operating features is an example of the extent to which welding tools have been developed to meet the specific requirements of production work.

A less elaborate production welding set-up, but, nevertheless, one meeting the needs of the job, was described by R. L. Rex, railroad mechanical specialist, Air Reduction Sales Company, who used the assembly-line layout developed by the Chicago, Milwaukee, St. Paul & Pacific for fabricating welded freight cars to illustrate the extent of mass production methods in a railroad shop. Employing manual welding, the emphasis here was placed on jigs, fixtures and positioning equipment and a layout that would accelerate the flow of the various car parts through the shop to the final assembly operation. For this shop an economical solution to the needs of the job was found in the use of relatively simple equipment which was effective in producing results on a mass production basis.

These two production methods—one utilizing both highly developed welding fixtures, and automatic welding machines, the other eliminating the automatic machines—while not extremes, do indicate the possibilities available to the railroads in selecting a welding set-up to fit the job. Probably automatic welding machines make possible a quality and consistency of welds that could not be attained by manual methods but they are not essential to the quantity production of rolling stock. Jigs, fixtures and positioning equipment, however, are necessary to insure correct alinement, a minimum of distortion and an increased speed of construction for any type of welding.

The two welding jobs mentioned here also demonstrate that welding has been developed and established as a dependable fabricating method to a point where the selection of equipment and procedures for the construction of all-welded freight or passenger cars is limited only by the requirements of the job and the adequacy of the user's budget.

Maintenance of Auto-Loading Devices

The increase in damage claims on automobile shipments on account of failure of hold-down chains in automobile-device cars has been called to the attention of individual railroads by the A. A. R. Mechanical Division and, in spite of improvement in some instances, the general condition still needs intensive attention and corrective action.

In too many cases, as pointed out in the last A. A. R. circular letter, empty device cars are set for loading automobiles with loading-rack hoist chains either too short or too long and not matching up with the pilot slot of the hand motor used in raising the racks. Special attention obviously is required when inspecting hold-down chains to make sure that all chains and their attachments are in condition to function as intended and hold the load safely.

In cases where the hold-down chain links or other parts are worn enough to reduce the original cross-sectional area 25 per cent, or are otherwise defective, the A. A. R. recommends repair or replacement. When end links are flattened and overlapped, they can sometimes be properly secured by welding. In repairing hoist chains, another thing which must be watched is the use of an even number of links in order to assure suitable movement of the chains through the hoist in correct alinement and without twisting.

Numerous other details require close scrutiny. Cars have left owners' shops with incorrect chain length in relation to pilot location which should be 3½ in. from the center of the pilot hole to the top of the horizontal link of the hoist chain. The sway-hook swivel forging, when it becomes worn, creeps around the bend of the hook, permitting the swivel forging to drop out of position in the bracket, causing excessive lateral motion of the rack and consequent lading damage. Guide rod and tie-down assembly-chain welds need careful inspection to make sure they are sound.

Defective threads in the turnbuckle structure often cause failure of the hold-down assembly and it is suggested that better results would be secured with 10 instead of the 16 threads per inch, as now used. Improved welding of turnbuckle arms to the spring caps or seats is recommended and evidently side frames

need to be reinforced where many are now breaking, about 52 in. back from the end of the frame where the floor leg is fastened to the frame.

It seems apparent that an organized campaign is needed on most roads to inspect and repair automobile loading devices more thoroughly when cars are being shopped for other repairs and thus avoid having to do this work at congested terminals. In this way, local car inspection forces will not be tempted, under the press of heavy demands for this type of equipment, to pass cars on for loading with automobile loading devices in questionable condition to carry a valuable commodity lading safely to destination.

Power Supply for Train Communication

There are apparently no great difficulties involved in developing power to operate train communication equipment on locomotives. This may be assumed from a reading of the A. A. R., Electrical Section, Mechanical Division, report on the application of radio and communication systems to rolling stock summarized elsewhere in this issue. On steam locomotives, it is only necessary to have a turbo-generator of sufficient capacity. On all Diesel-electric road locomotives, the generators which supply auxiliary power have sufficient excess capacity so that the train communication load can be added without danger of overload. Some Diesel-electric switchers have little generator capacity to spare but it is expected that communication demands can be kept within the load limits of these generators. It must not be assumed from this that there are no costs involved. On steam locomotives, the cost will be from $185 to $460 per locomotive, depending on the turbo-generator already on the locomotive and the choice of conversion equipment. On Diesel-electric locomotives, the cost may run from $250 to $400 per locomotive.

According to the A. A. R. Electrical Section, Engineering Division, report, summarized in the November issue of *Railway Mechanical Engineer*, there are no technical difficulties involved in supplying standby power to cabooses on the caboose track. It is suggested, however, that if 117-volt a.c. 60-cycle power were used for this purpose, it could be used for communication between the train crew and the yard office or dispatcher when cabooses are tied up so that no power need be taken from the caboose battery or engine. This statement emphasizes the desirability of having all sets operate from a 117-volt a.c. power.

Concerning caboose power, there are two schools of thought, one which proposes to use generators driven by internal combustion engines and the other, axle-driven generators and batteries. Costs of the axle-generator systems may vary from $1,300 to $1,800, while straight storage-battery systems would run from $800 to $1,300. The principal advantage of engines is adequate power supply without dependence on operation of the train or wayside power supply. Objections voiced by prospective operators are a complicated and perhaps expensive maintenance schedule and the use of such engines by unskilled operators. Advantages of axle-generator systems are that they may be used anywhere on any railroad without hazard, and that they are quiet in operation. As compared with the engines, they are at a disadvantage because they cannot directly develop 117-volt a.c. 60-cycle power, their capacity is limited and they require standby power facilities.

These differences in themselves are not so great as to determine choice of equipment. Railroads will select one or the other depending mostly upon operating requirements or limitations. They will also be influenced by power requirements for lighting and possibly other purposes. One thing is already evident. Some will use engines and some will use axle generators.

Spare Assemblies For Steam Locomotives

One of the major disadvantages of steam locomotives as compared to the Diesel-electric locomotive is the lower utilization that is usually obtained from the steam power. One of the major reasons for this differential in favor of the Diesel locomotive lies in the use of packaged units, or sub-assemblies that can be replaced in a body, for repair and maintenance. In some cases this amounts to such large items of equipment as the Diesel engine. Because the replacement time for many of the parts comprising the total locomotive is considerably less than the time that would otherwise be required for repairs, the time that a Diesel locomotive remains out of service for overhaul is greatly reduced and its time in service noticeably increased.

To date, however, no such large-scale attempt has been made to utilize the advantages of such a scheme with respect to modern steam power. Steam-locomotive repairs are still largely on the basis of holding the locomotive out of service until a defective part is overhauled. There are many instances where modern steam locomotives are held out of service much longer than necessary to make repairs to parts that, had spare units been on hand, could have been replaced in a fraction of the time. While this condition exists with respect to both boiler and machinery work, and on heavy, light, and running repairs, probably the most outstanding example of where out-of-service time could be trimmed is boiler work in Class 1, 2, or 3 repairs.

Boiler work has for a long time been responsible for extending the time required for heavy repairs. Boiler maintenance has not been reduced to the extent that machinery repairs have, and machinery repairs have an added advantage with respect to overhaul time in that the various groups, such as motion work, wheels, spring rigging, etc., are sent to various parts of the shop and the necessary work on them performed simultaneously. But there is a definite limit to the number of operations that can be performed on a boiler at any one time with-

out the workers interfering with each other. Thus even if the total man-hours of work on the boiler compared favorably with that on the machinery, the total time to finish the boiler repairs would still be high because the operations are of necessity performed consecutively rather than simultaneously. If this extra time could be reduced by having a spare boiler available for replacement, the time required for the complete back-shop repair could be substantially reduced.

The idea of a spare boiler for some classes of power is not new. It has been considered many times by many people. But recent trends give it added impetus. The success of similar systems in Diesel work is one, especially in regard to the feasibility of having spare engines, which may be considered the rough functional equivalent of the boiler. Improvements to the foundation and running gear, such as one-piece beds, roller bearings, lightweight reciprocating parts, and mechanical lubrication, are another. These developments have proved themselves capable of reducing the machinery-repair time. Still further savings might be attainable by not having precision-machined parts lying around exposed to dirt and grime while awaiting completion of boiler repairs. And not to be overlooked is the much greater ease with which such a program can be carried out today than in the past. Tolerances are much closer, greatly facilitating the interchangability of parts; at least one major railroad specifies its boiler alignment in terms of thousandths of an inch. There are fewer classes of power, and even among this lesser number of types, the trend is toward more and more standardization of as many parts as practicable.

All in all, it appears that recent developments in steam locomotive construction increase the advantages of having spare assemblies. The increasing cost of power, as well as the tremendous advantages of modern units over old locomotives, make it more imperative than ever to attain high locomotive utilization. One aid to attaining such maximum usage that certainly justifies investigation is to follow the lead found so helpful in Diesel repairs: study the advantages that can be had by keeping on hand spare boilers and any other sub-assemblies that are found to be bottlenecks to fast steam locomotive repairs.

The Problems of Coal Sizes

One of the problems with which the bituminous coal industry is concerned at the present time is how to reduce the tremendously large number of commercial coal sizes. This was the subject of the symposium at the ninth joint meeting of the Coal Division of the American Institute of Mining and Metallurgical Engineers and the Fuels Division of the American Society of Mechanical Engineers held at Philadelphia on October 25.

The best analysis of the causes for the large number of coal sizes, over one hundred of which were reported as being produced in Districts 9, 10 and 11, gave eight reasons, at least three of which pertained to the character of the fuel and to the mining and methods of cleaning and preparing the coal. Others had to do with the essential needs of the user and the remainder with commercial considerations. The most positive suggestion for improvement was that something can be done to eliminate size variations of 1/16 and 1/8 in.

A. A. Raymond, superintendent fuel and locomotive performance, presented the facts of the coal sizes received by the New York Central from 43 mines which emphasize the importance of differences in coals and coal preparation plant facilities as causes for size variation. The bottom sizes of double-screened coal ran from one to two inches and the top sizes, from three to five inches. The combinations of top and bottom sizes make possible a considerable number of coal sizes within a relatively small range at the top and bottom screens.

It is evident that in specifying coal sizes best results will be obtained by selecting that size, within the permissible limits of satisfactory results on the locomotive, which best meets the spacing of impurities in the coal and the needs of the preparation plant for the production of the cleanest coal. No doubt variations from these sizes will be expedient for commercial reasons such as the amount of coal required to supply other customers than the railroad. Such considerations would seem to outweigh the need for any greater degree of standardization than the establishment of a maximum top size and a minimum bottom size within which satisfactory results can be obtained on the locomotive.

NEW BOOK

WHO'S WHO IN RAILROADING, ELEVENTH EDITION. *Published by the Simmons-Boardman Publishing Corporation, 30 Church street, New York 7. 780 pages, 6 in. by 9 in. Price, $8.50.*

The first edition of this work appeared in 1885. It and the succeeding seven editions were known as the Biographical Directory of Railway Officials of America. Beginning with the Ninth Edition, published in 1930, the coverage of the book was broadened to include also leaders in the railway supply manufacturers' group, railroad labor leaders, regulating authorities—both state and federal, transportation economists, specialists in railway finance, educators concerned with railroad problems, I. C. C. practitioners, consultants, authors, editors, etc., and the name was changed to that borne by the Eleventh Edition. This edition gives special attention to war service records, including, in particular, those men who were commanding officers in the Military Railway Service. Recommendations and suggestions in the compilation of these biographical sketches were made by the combined staffs of the Simmons-Boardman railway publications and, in some instances, authorities outside the organization were asked to suggest the names of leaders in their more highly specialized groups. The book contains in the neighborhood of 5,700 sketches.

IN THE BACK SHOP AND ENGINEHOUSE

Two Boring Jobs

Two interesting boring jobs being done on a Bullard 54-in. vertical turret lathe, recently installed in the West Burlington, Iowa, shops of the Chicago, Burlington & Quincy, are shown in the illustrations. To accomodate extra high work in this machine, the side rails are extended upward 26 in. higher than usual. The machine is also equipped with a boring-bar attachment, applied between the turret head and the table center and used in making exceptionally long boring cuts.

The view at the left shows the more or less conventional operation of machining a cast iron smoke stack preparatory to inserting it in the smoke box. The stack is held in inverted position on the work table while the upper end is being trued and bored for the petticoat pipe fit with one of the cutting tools in the turret head. The side head of the machine is used at the same time for turning the inside extension of the smoke stack.

The illustration at the right shows an operation not normally considered possible on a machine of this type. It consists of boring and turning a large steam locomotive cylinder bushing which, in this instance, is 28 in. in diameter by 48 in. long finish size.

The bushing is firmly clamped on the work table in the usual manner and while the exterior is being turned with a tool in the side head, the interior is bored to finish size. This latter operation is accomplished by means of a three-cutter head which has power feed down a pilot boring bar suitably connected between the top head of the machine and the work table center.

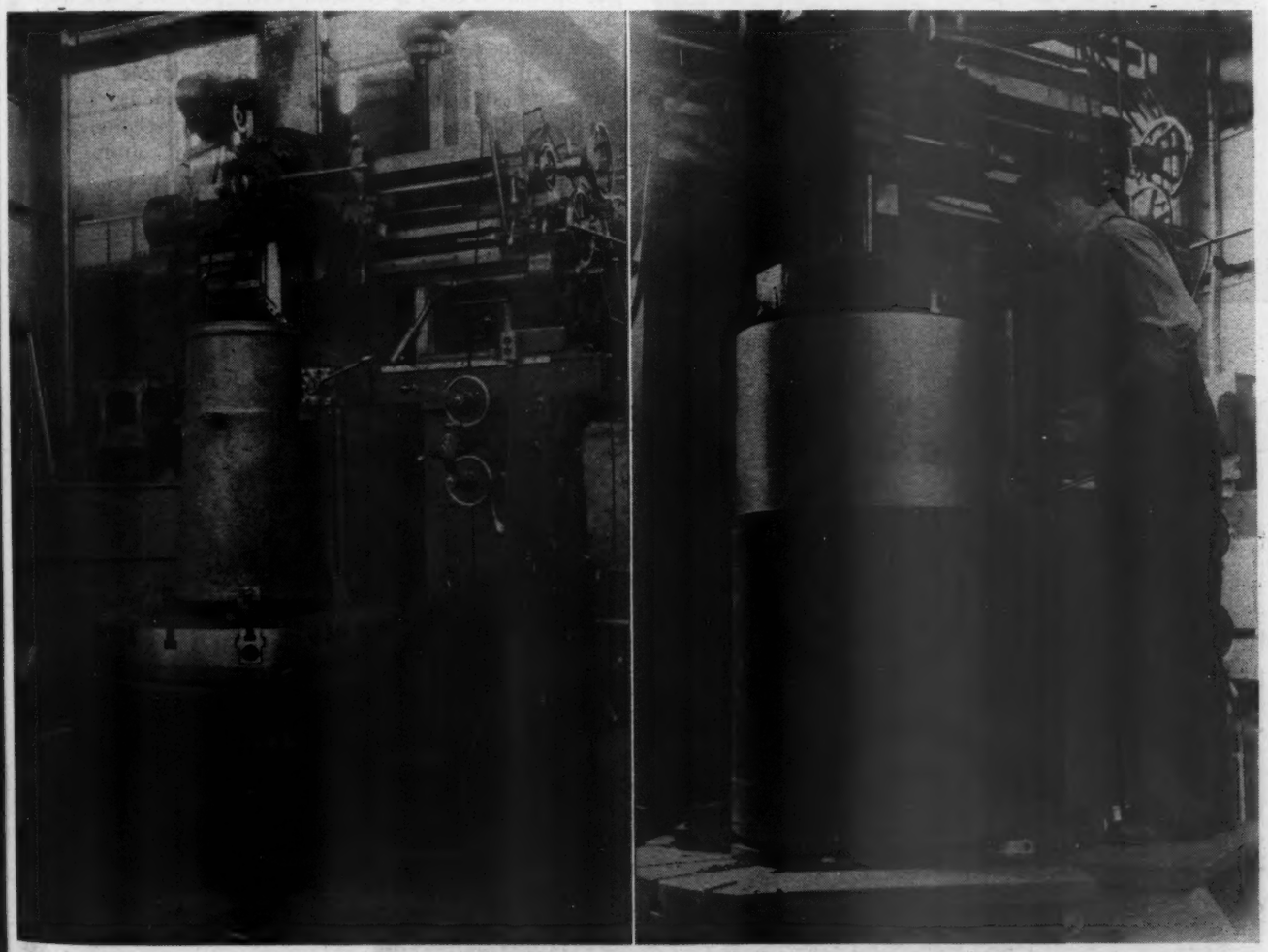
For satisfactory operation on work of this size, remote control for starting and stopping the machine without getting down on the shop floor is almost an essential. It not only increases production but is a safety feature. The push-button control box is shown in the operator's left hand as he checks the accuracy of the boring cut.

With the arrangement illustrated, a 28-in. by 48-in. cylinder bushing can be rough and finish machined in eight hours or about half the time required by former methods.

Crosshead Milling Job

An unusually interesting crosshead milling job, now being done on a G. & L. horizontal boring, drilling and milling machine, at a large locomotive repair shop, is shown in two of the ilustrations.

For modern steam motive power, the underhung crosshead of the Dean type, but with multiple ledge bearing in



Bullard 54-in. vertical turret lathe machining smoke stack (left) and large cylinder bushing (right)

a single guide, is giving highly effective service because of its relatively light weight, strong one-piece construction and long service life due to well-lubricated bearing surfaces more or less shielded from dust and abrasive materials. Nevertheless, wear develops in time and when it reaches predetermined limits, the crossheads have to be removed, old tin or babbit melted off, new metal applied and the crosshead remachined.

It is quite common practice to use block tin as the bearing metal on these crossheads and, when reapplied, the tin usually takes the form of a solid block of the desired outside dimensions enclosing the steel supporting ledges. The next operation is to machine grooves in the crosshead to correspond with ledges in the guide, and various methods may be used to accomplish this result. The main problem is not one of cutting hard or tough metal, as the block tin is readily machineable. The questions of how to secure desired accuracy and minimize set-up and machining time are, however, of primary importance, both because of labor cost and the fact that, in some instances, it may be necessary to keep locomotives out of service while this work is being done.

Gang-milling cutters used in machining multiple-bearing crosshead grooves on a G. & L. horizontal boring mill

The grooves may of course be cut on a planer, but in general both the set up and cutting time are longer on this machine, especially if due attention is given to accuracy. One means of assuring accuracy when a planer is the only or best machine available to do this job is shown in the third illustration. In this case the crosshead is mounted on a V-block supported mandrel which can be accurately lined up on the planer bed and the crosshead grooves cut on either side by simply reversing the cutting tool in the planer-head tool post.

Another method is to mount the crosshead on an indexing fixture in a Morton draw-cut shaper, this fixture holding the piston-rod center hole in accurate alinement with the shaper ways and hence assuring crosshead grooves parallel with the center line of the piston rod. When the grooves on one side are completed the crosshead is simply turned 180 deg. in the indexing fixture, and the grooves cut on the other side with every assurance that they will be accurately parallel and spaced with respect to the opposite grooves.

For production work, where a number of crossheads of the same type and size have to be machined, however, the set-up shown on a horizontal boring, drilling and milling machine has definite advantages. In this case, the crosshead is squared up and firmly clamped to the boring-mill table. A set of milling cutters of the correct thickness and required differences in diameter is applied to the large boring-mill spindle and spaced so that the top surface of the crosshead (side nearest the vertical column of the machine, in this instance) is half faced and the two grooves properly positioned and accurately cut in a single downward pass of the gang milling cutters. Operation of the milling cutters with the feed in the reverse direction on the other side of the crosshead finishes facing the top surface of the crosshead and cuts the opposite grooves accurately in line with those on the nearer side.

Once the gang milling cutters are adjusted to stand-

Conventional set-up of multiple-bearing crosshead on V-block-supported mandrel to assure accurate planing of all bearing surfaces

The crosshead grooves are formed in a single pass of the milling cutters

ard dimensions for a production job and one of the crossheads is set up on the boring-mill table, the actual machining time is only 15 min., or slightly over, which may be compared with upwards of four hours by the method formerly used.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Allowable Stresses In Braces and Stays

Q.—What is the allowable stress permitted for a boiler backhead brace where the jaws are fusion welded to the brace rod? —M. K. J.

A.—Rule 3 of the Interstate Commerce Commission's Laws, Rules and Instructions for Inspection and Testing of Steam Locomotives and Tenders, and other than Steam Locomotives provides: (a) For locomotives constructed after Jan. 1, 1915, the maximum allowable stress per square inch of net cross-sectional area on firebox and combustion-chamber stays shall be 7,500 pounds. The maximum allowable stress per square inch of net cross-sectional area on round, rectangular or gusset braces shall be 9,000 pounds. The above rule applies only to brace rods that are forged in one place. The fusion welding of jaws to the brace rod is not permitted.

The American Society of Mechanical Engineer's boiler code permits maximum allowable stresses of 9,500 lb. per sq. in. in unwelded stays or braces and unwelded portions of welded stays or braces for lengths between supports not exceeding 120 diameters, 8,500 lb. per sq. in. for lengths between supports exceeding 120 diameters and 6,600 lb. per sq. in. for welded portions of stays or braces. Welded portions of stays or braces referred to above are for stays or braces that are fabricated by forge welding, such as forge welding the jaws to the brace rod.

Overheating of Firebox Side Sheets

Q.—We have considerable trouble on our 4-8-2 type locomotives due to the over-heating of the firebox side sheets and the resulting warped and cracked plates. Although we have reduced the washout period for these engines and our inspections show the sides sheets to be free of oil and scale, the conditions have improved but they are not entirely corrected. Are there any other contributing factors that might possibly cause this condition?—F. T. S.

A.—Overheating of firebox side sheets can be caused by poor circulation. The circulation of the water in the water space between the firebox sheet and the outside wrapper sheet must be rapid enough to remove the steam bubbles from the surface of the plate as soon as they are formed to allow the water to come in contact with the firebox plate at all times. The faster the circulation of the water the faster the bubbles of steam are carried away and the better is the contact between the metal and th water, with the resulting cooling of the firebox sheet. When the circulation is so poor that it is insufficient to remove the steam bubbles from the firebox sheets as they form, the steam bubbles act in the same manner as a film of oil on the plates and form an insulation between the water and the plate. The condition reduces the amount of heat being absorbed from the firebox plates and results in the overheating of the sheets.

Machining Eccentric Cranks

Eccentric cranks for steam locomotives are subject to wear and breakage and, in some instances, new lightweight designs are required in connection with locomotive improvement programs involving complete new lightweight reciprocating parts and recounterbalancing locomotives for high-speed operation. For one or more of these reasons, most large railway shops are required to make a considerable number of new eccentric cranks in the course of a year and the equipment shown in the illustrations can be used effectively in performing the major machine operations.

Referring to the first two views, a Turchan follower attachment will be seen applied to an Ingersoll 54-in. vertical mill at the Marshall, Texas, shop of the Texas & Pacific. A pair of eccentric cranks are rigidly bolted to the machine table and a template, cut to the exact desired finish size, is supported in a frame on the table just in front of the cranks. The tracer tip is equipped in this instance with a wheel 8 1/16 in. in diameter which follows around the template and, by means of suitable hydraulic controls, causes the 8-in. vertical milling cutter to cut an identical path around the outside of the eccentric cranks, both of which are quickly and accurately finished to blue-print size and shape.

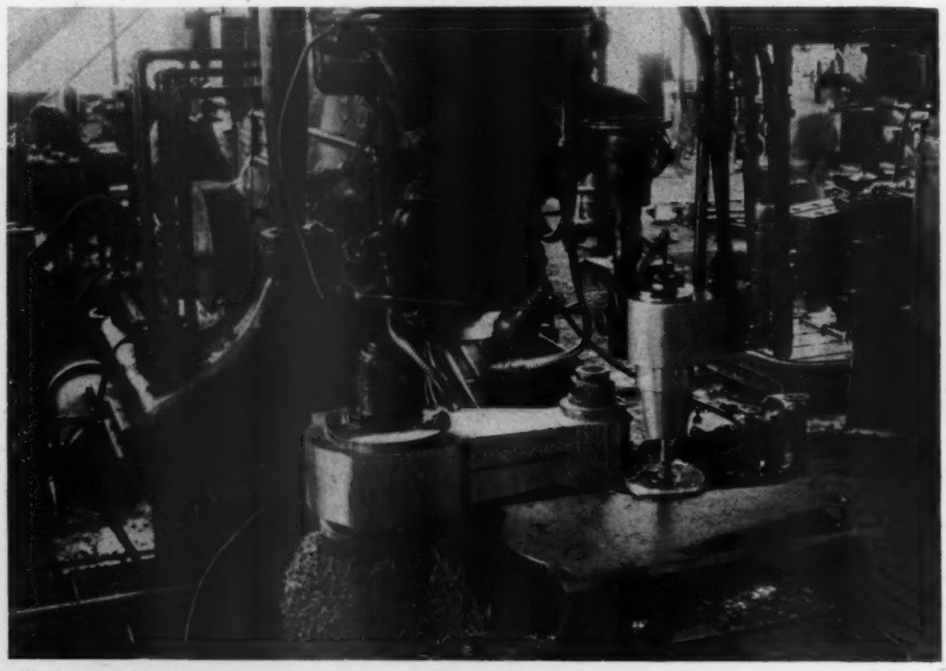
Fairly heavy cuts may be taken with this set-up, but

it is better to limit the depth of cut to 5/8 in., for example, rather than attempt to take all the machine will stand. The accuracy and smoothness of the work are of high order and production greatly stepped up since the milling cutter automatically machines any desired straight, angular, or curved surface called for by the template without the time and labor involved in making work or machine adjustments which would otherwise be required.

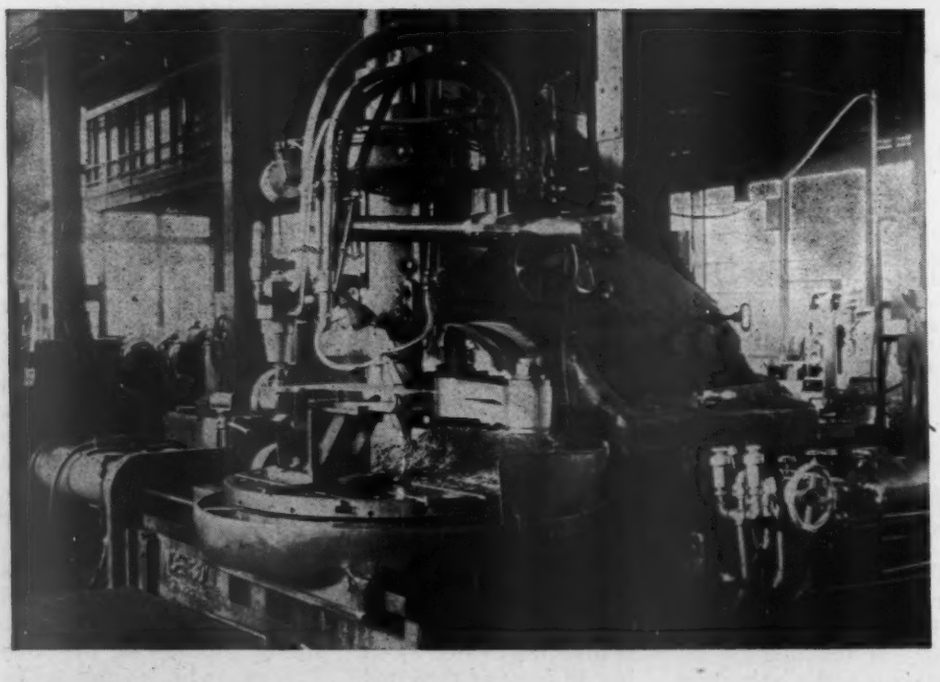
The way in which the Turchan follower operates can be readily seen, in general, by reference to the second illustration which shows the tracer unit and neccessary pipe connections to the main head of the vertical boring mill, the actuating hydraulic cylinders at the rear of the machine which move the main head and milling cutter in and out, and the pair of double-acting cylinders at the extreme left which move the work table back and forth. The combination of these two motions (with the mechanical feeds disconnected) permits the milling cutter to follow any desired path with respect to the work as called for by the template and all-but-human tracer unit.

The precision control valve, actuated by the tracer tip and wheel, is, of course, the heart of this mechanism for it lets just the right amount of oil into each pair of cylinders at the right time.

In this Turchan follower application, eight valves have been installed in the pipe connections to give rapid traverse when desired. No superior skill is required of the operator who, however, must be sufficiently interested to absorb instruction and learn from experience what the attachment can really do on an accurate production job. Not the least important advantage of this device is the fact that it may be used to machine the butt end of a long main rod, for example, without swinging the rod over a large floor area which must therefore be cleared.



Turchan follower attachment on an Ingersoll 54-in. vertical mill machining eccentric cranks



Turchan hydraulic actuating cylinders, control valves and piping, as applied to the vertical mill

With the Car Foremen and Inspectors

Maintenance of

Steam-Heat Equipment*

By L. A. Richardson†

The subject of steam-heat maintenance from the railroad's viewpoint includes two main features: (1) prevention of train delays and steam heat failures; and (2) provision of a comfortable condition in cars for the traveling public. Both of these have to be taken care of with a minimum expenditure of labor and material, and, many times, during a very short lay-over period.

This is entirely possible if a systematic method is followed for periodic inspection and overhaul of equipment. With the older-type equipment, it was absolutely necessary to overhaul at least once each year for satisfactory operation. With the improvements that have been made in the newer equipment, we believe this period can be lengthened to two years.

I will outline our ideas on maintenance of equipment and will appreciate a thorough discussion as to its merits, especially the time periods and method of keeping records.

The subject of underneath equipment, including end valves, covers several styles of traps, regulators and valves, would take considerable time to go into detail on each one, so I have taken each item in general without too much detail on any one.

Maintenance of many of the following items would consist of thorough inspection before each heating season and a general overhauling at periods not to exceed two years.

We have had in mind for some time that it would be a good practice to have the date of inspection and overhaul of steam-heat equipment stenciled on the car, or a record placed in the car when this work was performed. This record would follow the car and a program would be set up as is now done with other equipment on cars such as journal boxes, a.c. air filters, air brakes and electrical equipment. With a program and record system of this kind, we believe, a great many failures and train delays could be avoided.

End-Valve Maintenance

All end valves from the No. 1104, to the 2½-in. No. 1117 should be inspected at the beginning of each heating season. The valve should be operated from the platform extension to see that this linkage is in operating condition, also from the weighted ball-type handle to check the hold-open feature of the valve.

The stem will, in most cases, need repacking or the addition of the 1104-N packing ring. The stem should have sufficient packing so that car inspectors need only to tighten the packing nut during the winter season.

When a car is shopped, the valve should be taken apart and the main valve and seat checked for wear and wire drawing. The bleeder valve should be inspected along with the pins, cams, and levers for excessive wear.

If the main seat is worn or wire drawn, it can be reseated with one of several types of reamers developed for this job. After the work has been completed, the valve should be tested under high-pressure steam for leaks and operation.

The strainer in train-line tees and crosses should be removed and cleaned at general shopping of cars which should, under normal conditions, be sufficient.

The No. 124 shut-off and drain valve located in each branch pipe should not require maintenance in yards if given a thorough overhaul when cars are shopped. We do find, on many occasions, where this overhaul has not been made that we have a constant steam leak at the drain port. This is due to a bad back seat in the valve which should be tight when the valve is in open position.

Constant-Pressure Valve

The No. 244 constant-pressure valve is an important part of the system and should be removed from the car and overhauled annually. It should be completely disassembled, the valve seat ground in, or a new valve assembly applied. The diaphragm should be inspected, checking particularly for cracking at the edges where continual flexing occurs. When the valve has been reassembled, it should be tested and adjusted under steam pressure.

The BA-440 regulator, equipped with an economy enclosure and the SS valve assembly, has greatly reduced the maintenance problem of this regulator. Before each heating season, this regulator should be tested under steam pressure. If this valve is operating properly, and the seat is satisfactory, there should be no blow of steam. If the regulator passes this test, it should function properly for the heating season.

Within a maximum of a two-year period this regulator should be given a thorough overhaul. The regulator valve assembly, bellows-packing assembly, and main bellows should be removed, cleaned, the valve reseated and all parts inspected for wear. When the regulator is assembled it is important that the operating rod be free in the guide nut in the regulator head and that the main operating-rod spring is not worn or rusted.

Steam-Trap Maintenance

All steam traps with the exception of the No. 155 trap should be overhauled prior to the heating season. They should be taken apart, the valve and seat examined, renewing when necessary. The adjusting screw and lock should also be examined. After reassembling, the trap should be adjusted under steam pressure to check for leakage.

* Part of a paper presented at the October 7 meeting of the Northwest Carmen's Association, at St. Paul Minn.

† Manager, St. Paul o..ce of the Vapor Car Heating Company.

At the two-year period, the No. 155 trap should be thoroughly overhauled, giving the valve assembly and bellows the same attention as the BA-440 regulator.

The procedure for making a complete test of heating equipment on cars which are not due for overhaul would be as follows: Connect the car to the yard steam supply and place a dummy coupler on the opposite end or connect to the next car. The test should be made with at least 50 lb. steam-pressure.

Check all No. 124 shut-off valves and see that they are in open position. Place all floor and overhead admission valves in closed position. Make inspection of all regulators at this time. They should *not* have a continuous blow of steam. Conduits, end valves, and all branch piping should also be inspected. Admission valves should then be moved to the *On* position to see that a complete heating circuit is made in all coils.

Maintenance of 900-Type Regulators

From past experience with the No. 900, 901 and 902 regulators, we believe that inspection should be made under steam pressure and with the lever cover off the regulator. Check should be made to see that the operating rods are free in the guide nuts; that bellows seals are not leaking; and that the valve is seating properly. If the regulator passes this test, it should function properly for the season.

Every two years, regulators should be completely disassembled, cleaned and the valve seats ground in. Bellows packing should be inspected and operating rods must be free in guide nuts.

After overhauling, the regulator should be tested under steam pressure. As this type of regulator has only been in service a relatively short time, we have found little need for changing the adjustment. However, this will not always be true, and as wear develops it will be necessary to remove the solder seal and adjust the regulator, as outlined in the manual. After the regulator has been readjusted, the solder seal should be replaced. This adjustment should be made in the shop. Avoid the practice of changing adjustment in yards.

Loop Equipment

On Vapor loop equipment, the following attention should be given each season: The No. 244 valve and No. 900 regulator should be given attention as previously outlined.

The flow-limit valve should be disassembled and thoroughly cleaned. Particular attention should be given to see that the valve seat is absolutely tight. The spring should be examined and, if rusted or otherwise weak, it should be replaced. This valve is an important part of the loop system and must be given this attention to avoid possible heat failures.

At this time of general overhaul, the regulator should be completely dismantled; flow limit valves and retarders should also be taken apart, cleaned, inspected and repaired as necessary.

Testing of the loop system before each heating season and complete overhaul would be as follows: Close all admission valves; check all No. 124 shut-off valves and see that they are in *Open* position.

Connect to the yard steam supply and see that there is no continuous blow of steam at the regulator. If a slight blow is found, it would indicate a faulty loop retarder. If a heavy blow occurs, it would indicate a bad valve in the regulator or a bad No. 900-E bellows.

After this test, open each admission separately and check for blow at the regulator. If a blow occurs, it would indicate a bad retarder or dirty seat in the return from that particular coil.

Wash-Water Heating Equipment

The maintenance program for the BA-530 hot-water regulator should be about the same as previously outlined for the BA-440 regulator.

The No. 525 hot-water mixing valve should be cleaned and inspected once every year, more often if bad water prevails. The cleaning of lime from this valve and inspection of the bellows is about the full extent of repairs.

The water heater itself should have a thorough cleaning at regular intervals to keep up its efficiency and prevent stoppage of the tubes.

(Mr. Richardson here discussed at considerable length and showed slides illustrating the maintenance of Vapor conduits.—Editor.)

Maintenance of Control Equipment

Proper operation of passenger-train-heating equipment is dependent upon a systematic maintenance program designed on the basis of preventative maintenance rather than simply repairing equipment when failure occurs. This consists of periodic overhauling of all items normally subject to mechanical wear and replacing any worn parts before failure occurs.

In between overhauling periods, equipment should be checked under steam for defects. If the steam admission valves are properly cleaned and overhauled periodically, little difficulty, if any, will be experienced during the heating season.

Starting with the electrical controls, consisting of the control panels and their associated circuits, it is essential that the wiring to the thermostats and valves be kept free from grounds. Even relatively light grounds, which normally would not be serious as far as car-lighting circuits are concerned, can result in erratic operation of the thermostatic circuits. These circuits can be checked at the time the car wiring is checked by turning on the blower and selector switchers. Grounded wiring will then show up and can be repaired.

It is the practice of some roads, at the time the cars are shopped, to remove the control panel from the car and to check the panel operation on a test bench designed for this purpose. This permits inspection of the back of the panel to determine the condition of the soldered joints and wiring. Relay contacts can be readily inspected and, if necessary, cleaned up with crocus cloth. This applies particularly to the open-clapper type relay. The enclosed type of relays can be inspected without removing the cover. Little trouble will be encountered with the enclosed type of relay, since they are protected from dust and dirt.

While the panel is on the bench, the blower and temperature selector switches can also be checked and necessary repairs or replacements made, as required. On panels destined for use with double-bulb thermostats, the set-down resistors should be checked with the set-down meter and any defective resistors replaced. With this procedure, the control panel should go from shopping to shopping with little, if any, yard maintenance. The only maintenance required in the yards would be a seasonal checking of the set-down resistors and visual inspection of the relay contacts.

The thermostat moutings should also be inspected and checked for loose connections. On the spring-suspended type of mountings, broken springs should be replaced. Here, again, if the mountings are properly inspected and placed in first-class condition at the time of shopping,

yard maintenance should be greatly reduced. The plug connections to the steam admission valves should be kept clean and tight. A check before each heating season in the yards should suffice to accomplish this.

Steam Admission Valves

The maintenance of steam admission valves should also follow a definite program. In the case of the earlier type of solenoid valves, such as the No. 1620 series, it is essential that the wings and bodies be thoroughly cleaned when overhauling the valve. The foreign matter that collects can readily be removed with Oakite No. 32 or similar solution. The parts removed, such as wings, bonnets, etc., can readily be dipped in the solution, rinsing them thoroughly with clear water after the effervescence stops. The inside of the valve body can be cleaned without removing from the car by swabbing it with the solution and then pouring in clear water after the effervescence stops. Originally, these valves were equipped with a packing type of seal around the valve stem which sometimes would freeze to the stem and cause the valve to stick. This can be overcome by using a metallic type of sealing arrangement. No lubrication is required on the metallic seal. When reassembling the overhauled valve, the normal care should be exercised with regard to alignment of parts.

The snap switch should be inspected for burnt contacts and its toggle action should be checked. In reapplying the switch, the compensator arm and switch should be adjusted to snap the switch just before the plunger travel is completed.

It should be remembered, of course, that in most cases these valves are from 10 to 15 years old, and wearing of the body and wing is to be expected. This situation can be improved by the use of durochrome plating of the wings. The additional thickness of the plating compensates for the wear and reducing leakage around the wing.

If these valves are thoroughly cleaned and properly reassembled, they will operate from overhauling to overhauling, and should require little actual servicing other than an occasional checking for free operation.

Electrically Operated Cut-Off Valves

On the later type of equipment, where zone heating is used, a solenoid admission valve of the cut-off type is used. Unlike the earlier types of valves which directed the flow of steam, these valves are electrically operated cut-off valves. Valves controlling the floor-heat radiation are normally open and are closed electrically. The valves controlling the steam to the overhead radiators are normally closed and are opened electrically.

The maintenance of these valves follows the same pattern set for the earlier valves. They should be completely dismantled periodically and thoroughly cleaned. When overhauling, the needle inlet valve assembly can be removed with a spark-plug wrench. If the seat is badly wire drawn, the needle valve should be replaced rather than attempting to lap in a new seat. The needle valve should operate freely, without binding or gumming due to deposits of foreign material. Unless the needle valve is clean and free when the valve is overhauled, it may result in a sticking valve before the next scheduled overhaul.

In order to reduce the maintenance time in yards to a minimum, particularly on cars with short layover periods, we would suggest that the maintenance men, when overhauling a valve, simply replace wearing parts, such as needle valves, plungers, wings, stems, snap switches, etc., with new or reclaimed parts from stock. The parts removed can then be forwarded to some central point for checking and repairing, or for scrapping, as the case may be. This practice is followed by most roads. It has several decided advantages in that it reduces the job of yard overhauling a valve. Furthermore, the repair and reclaiming of parts removed can be handled on a volume basis with resulting reduced cost, and less waste, since much closer supervision can be maintained over the work. This method is also of advantage with regard to outlying points, where forces and facilities are limited.

C. P. R. Reclaims Passenger Car Carpets

When parlor, sleeping and dining cars are in the shop for the repairs the carpets are usually found to be in good shape except for the center aisle section, a condition that could normally be expected in view of the greater foot traffic over that portion of the carpet. Therefore, the Canadian Pacific is using a method of repairing the worn carpets at its Angus shops, Montreal, Que., that permits salvaging the good parts of the carpet and eliminates the additional work required to fit a new carpet to the passenger cars. As the carpet wings that extend from each side of the center strip around the seats comprise

The new center strip is dyed to match the faded colors of the side wings—For comparison a new piece undyed is shown on top of the center strip

A car carpet showing the worn center section—The side wings are in good condition

the greater percentage of the total carpet area, the salvaging represents a substantial savings of materials.

Although in good condition, the carpet wings are usually found to be faded and for that reason they would not match in color new material of the same design even after they are cleaned. To give the carpet a uniform appearance the new center strip is first sent to the dyeing room where its color is changed to correspond with that of the faded carpet wings. One of the accompanying illustrations shows the effectiveness with which the color of the new strip is changed and made to blend with the old carpet material. Once the appearance of the new material is satisfactory it is only necessary to lay the new strip over the old piece, cut it to the same shape and then sew it to the old carpet wings. For sewing the seams the shop is equipped with a 60-ft. sewing machine.

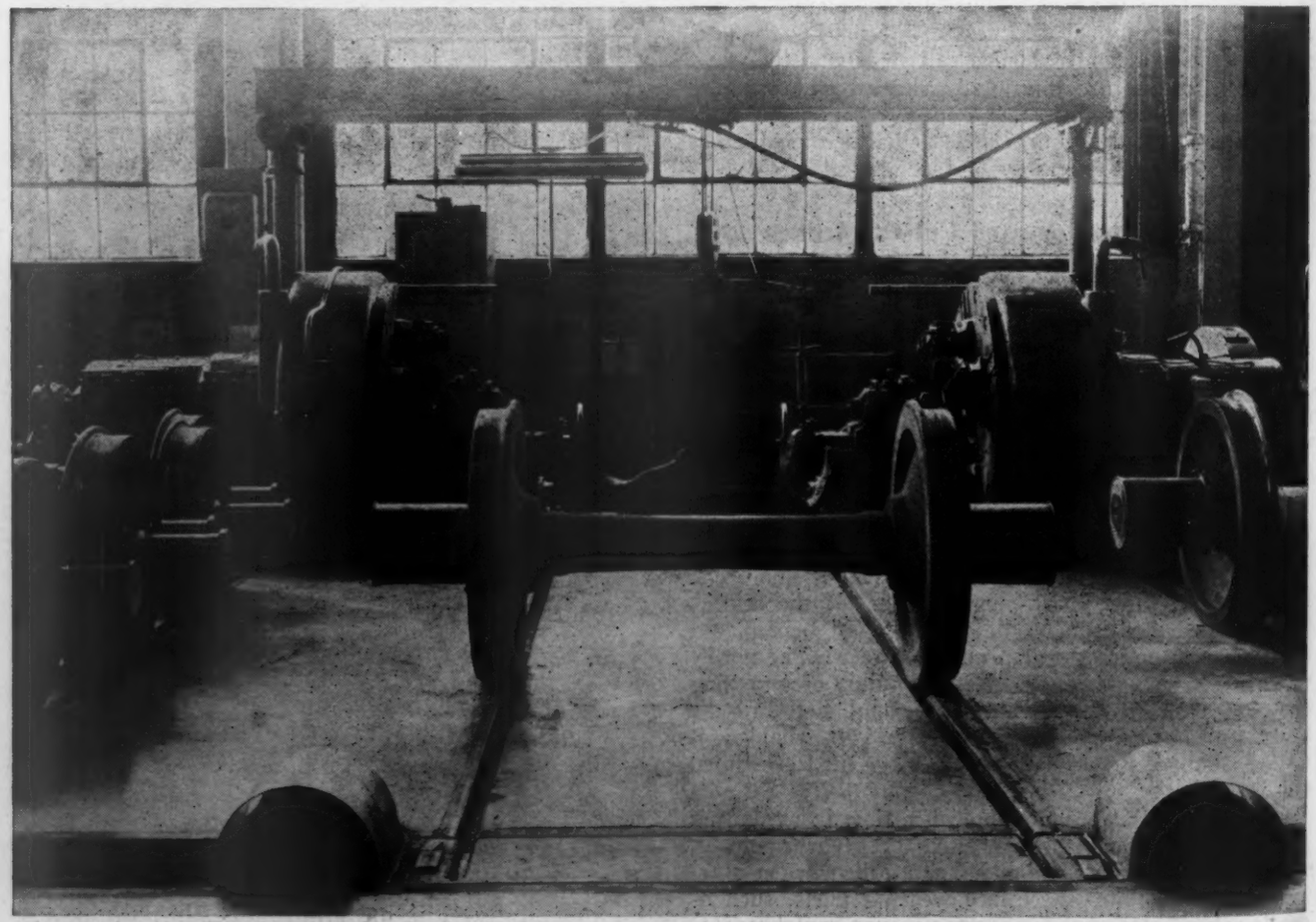
Sewing a carpet seam on the 60-ft. sewing machine

Wheel Transfer Table

The illustration shows in the background a Sellers 50-in. car-wheel lathe recently installed in a new shop with self-contained traveling crane and three-ton pneumatic hoist for handling mounted wheels, and a standard gage track leading to a neat and easily operated transfer table which permits wheels to be moved to and from temporary storage tracks on either side of the machine.

The transfer table, or dolly truck, shown in the foreground, is 14 in. wide by 67½ in. long by 3 5/16 in. deep, set flush in the floor and designed for transverse movement in a shallow pit by means of small supporting wheels on 8¾-in. gauge track. The dolly frame is made of a 12-in. 25-lb. channel, reinforced on either side with a ¼-in. by 2-in. by 2-in. angle and this frame is mounted on four 6-in. cast-iron roller-bearing wheels with stainless-steel protective shrouds applied over the wheels..

The bed of the dolly has two 1½-in. grooves, spaced 4 ft. 8½ in. apart on the upper surface, so a pair of mounted wheels may be easily rolled onto the dolly without change of elevation. When suitably blocked with small shims, the wheels and the transfer dolly may then be pushed with little effort up or down the shop to the desired track on which the wheels are to be rolled.



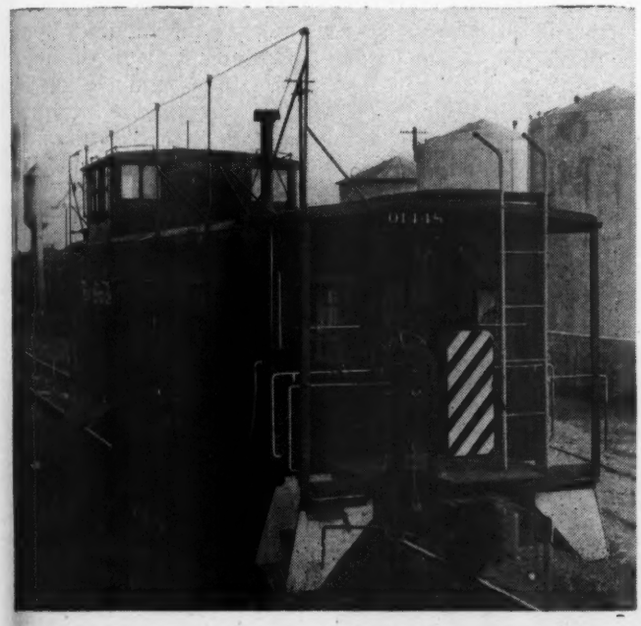
Transfer dolly for moving mounted car wheels to or from the Seller 50-in. car-wheel lathe in the background

ELECTRICAL SECTION

Propane Gas Engines For Caboose Power Supply

THE Denver & Rio Grande Western has equipped a number of locomotives and cabooses with train communication, VHF radio being used on the locomotives, and both VHF radio and inductive type communications on the cabooses. The standby power required for the VHF set is 125 watts, while the transmitting load is 250 watts. The induction set draws 100 watts when standing by and 300 watts when transmitting.

Power for operation of both the VHF and induction equipment on the cabooses is supplied by a 1,500-watt, 115-volt, 60-cycle, a. c. power source, manufactured by D. W. Onan & Sons. This unit consists of a generator, driven by a four-stroke propane gas engine. Propane gas is used because it is considered safer than gasoline, especially in the event of a collision or other damage that might result in fire. The engine has two cylinders, horizontally opposed, with an L-shaped head. It has a compression ratio of 6.3 to 1, is air-cooled and is rated 4.5 hp. at 1,800 r. p. m. when operating at 2,000 ft. above sea level. The reason for an engine of such high rating is that the railroad in places reaches altitudes of 10,000 ft. and at this altitude, due to the decrease in atmospheric pressure, the engine delivers between 2½ and 3 hp.



The engine is self-starting. A push button in the caboose reverses the polarity of the auxiliary windings in the generator, converting it to a motor for the purpose of starting the engine.

When the engine is running, the starting windings are used to generate d. c. current for charging a 12-volt starting battery.

The propane gas for the operation of the engine is stored in two 100-lb. tanks located under the caboose. These two tanks hold sufficient gas for operating the engine 140 hours. They are equipped with automatic regulators so that when the gas pressure in one tank drops to two pounds, the gas feed line is automatically connected to the second tank. The gas tanks are securely chained in place on a carriage in two compartments directly below the engine-generator.

The engine compartment in the side of the caboose is air cooled by an 18-in. I. L. G. electric ventilating fan, rated 110-volts, 60 cycles, a. c. which operates off the generator. This is essential for operating in hot weather.

The installation was made and placed in service under the direction of W. W. Pulham, superintendent of communications, and under the supervision of E. H. Musgrove, radio engineer. The major items of VHF and induction radio equipment were furnished by the Aireon Corporation.

Above: Caboose showing the induction antenna at the left and the VHF antenna on the cupola—Right: Engine generator and fuel tanks on the caboose—W. W. Pulham (left), superintendent of communications and J. K. Peters, mechanical engineer, D. & R. G. W.

The Carryphone Takes a Bow

By W. R. Triem*

The Carryphone in place in a cabin car connected to the larger batteries on the car

ROUNDING out its inductive train communication system perfected after years of cooperative activity with the Union Switch & Signal Company, the Pennsylvania Railroad recently placed in service a portable unit called the Carryphone.

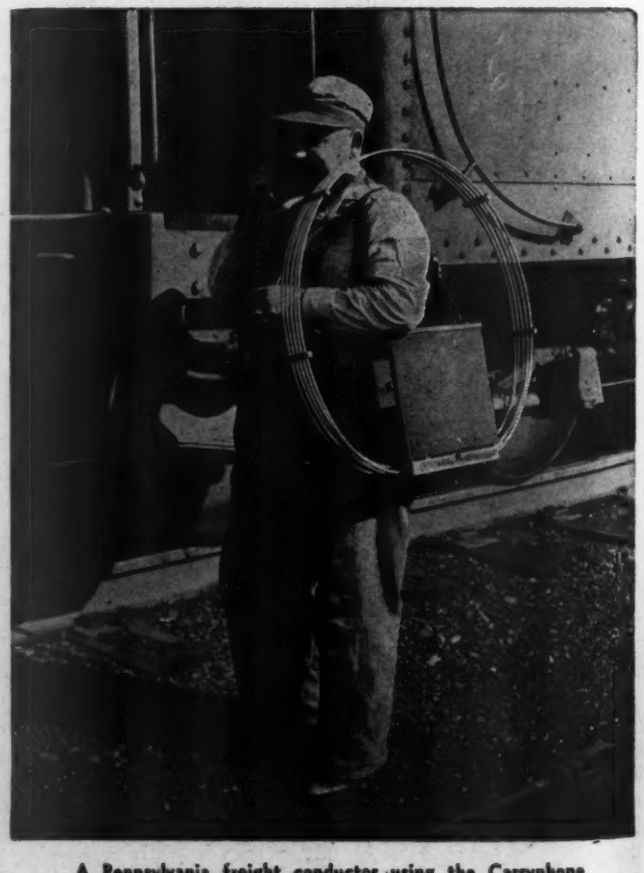
The Carryphone is a portable inductive telephone set for use of trainmen and other employees, primarily as an adjunct of the inductive trainphone system which is now in regular use between Trenton, N. J., and Phillipsburg, N. J., on the Belvidere Branch of the New York Division, and between Harrisburg, Pa., and Pittsburgh, Pa., on the Middle and Pittsburgh Divisions of the Pennsylvania. This new telephone apparatus similar in many respects to a "walkie-talkie," but employing induction instead of space radio, is also suitable for many purposes not involving use of the existing train communication systems. It is expected to be found valuable on wreck trains and work trains where the operation of derricks and machines of various kinds must be coordinated and directed from one location on the ground, as well as in many other fields of railroad operations.

Early in 1944 joint development and experimentation in the field of train communication by the Pennsylvania and the Union Switch & Signal Company, had produced a workable inductive telephone system, employing 5,700-cycle current and amplitude modulation. Later in the same year, trials of a system employing 88-kilocycle and 144-kilocycle frequencies, with frequency modulation, warranted its adoption in place of the earlier one. Trials and development work on the Belvidere Branch of the Pennsylvania with the new scheme have continued, and together with the large-scale experiment on the four-track main line of the Pennsylvania, between Harrisburg and Pittsburgh, has produced a train communication system satisfactorily meeting railroad requirements. Today, about 300 locomotives, 100 cabin cars and 16 wayside stations are in service on 1,056 miles of main tracks.

The Carryphone embodies features of the parent system, and operates on 88 kilocycles, one of the frequencies of this two-frequency system. Just as the inductor loop on the locomotive and cabin car creates a magnetic field, inducing currents in adjacent wire lines and tracks, so does a small 30-in. loop on the Carryphone perform the same functions on a smaller scale. In like manner, the receivers on the locomotives and cabin cars are provided in miniature in the Carryphone.

Details of design of the Carryphone are: Cabinet, size —16½ in. long, 12¾ in. high, 4⅞ in. wide; inductive loop—5 turns, ¼-in. tubing, 30 in. in diameter; weight—29 lb.; power—two storage batteries, 6 volts and 2 volts; capacity—45 minutes' transmission, or 6 hours' reception; approximately 2 hours' ordinary service; transmitter output—2.5 watts; telephone—hand-set with push-to-talk button; volume control—automatic; range—Carryphone

(*Continued on page 678*)



A Pennsylvania freight conductor using the Carryphone

* General Superintendent of Telegraph, Pennsylvania Railroad.

Cleaning Traction Motors

Time required for cleaning a motor reduced from eight hours to thirty minutes by means of stripping tank redesigned for vapor degreasing

THE time required for cleaning Diesel-electric traction motors has been reduced from eight hours to thirty minutes in the Silvis, Ill., shops of the Rock Island by the use of a vapor cleaning tank.

Originally, the motors, when brought to the shop for their periodic 150,000-mile overhaul, were left outside the shop where the heavy grease and dirt were scraped off while the motor was still assembled. When the man who did the scraping had finished with his work, he would ring a bell to call a number of men from their work in the shop to go out and bring the motor inside.

The motor was then dismantled and the armature taken outside. The dust was first blown off, after which the armature was cleaned with a jet of air and cleaning solution. This did a rather ineffective cleaning job, some of the dirt being blown in the crevices in the coils and ventilating slots from which it was practically impossible to remove it. The armature was then brought back into the shop, after which the motor frame was taken outside and given the same treatment. About 50 gal. of cleaning solution was used for each motor. This can be, but in this case was not, reclaimed. The total time required was about eight hours.

Vapor Cleaning

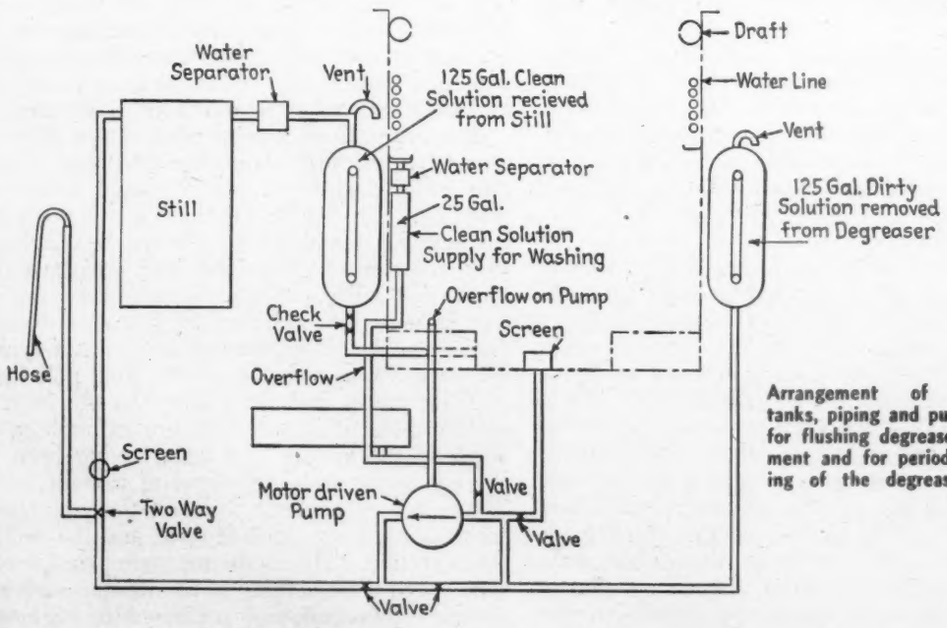
The present method of cleaning consists of bringing the motor into the shop without disassembling and without outdoor cleaning. The end frames and armatures are removed inside after the motor is inspected and given a running test. Then the armatures and frames are cleaned separately in a vapor degreasing tank.

The tank is about 8 ft. square, by 8 ft. deep, and contains about 75 gallons of perchlorethylene with an inhibitor. Electric emersion heaters near the bottom of the tank vaporize enough of the degreasing agent to fill the tank with vapor. The part to be cleaned is lowered by the crane into the vapor. Since the temperature of the part is much lower than that of the vapor, there is a rapid condensation of vapor which results in a flow of liquid degreasing agent from the surface of the coils and metal. This results in a lowering of the level of the vapor, and when the part is no longer covered with vapor, it is lifted out of the tank until the vapor again rises to the top of the tank. This is repeated three or more times, after which the part is rinsed by means of a hose with clean liquid pumped from the bottom of the tank.

If the part cleaned is an armature, it is then allowed to drain at an angle of 45 deg. To provide for this, there is a hinged fitting on one edge of the tank in which the armature end of the shaft is rested while the crane is used to lower the pinion end, as shown in the photograph.

This process results in dry armatures and field coils. After degreasing there is a dry powder residue on the surface of the part which is readily removed with an air hose. The drying is so thorough that an insulation resistance measurement taken after degreasing shows armature coil resistance values which are comparable to those taken just after an armature is removed from the vacuum impregnator.

The degreasing tank is an adaptation of a tank originally designed for stripping. At the bottom, there are electric heating coils which vaporize the perchlorethylene. Near the top, and around the edge of the tank are water cooling coils which serve to condense excess vapor before it flows over the edge of the tank. As a further protection against overflow of vapor, there is a pipe at the edge of the tank which is slotted along its inner edge for the full length of the pipe. Air is exhausted from this pipe and vapors which might be an annoyance to the



Arrangement of auxiliary tanks, piping and pumps used for flushing degreased equipment and for periodic cleaning of the degreasing tank

Operator in the process of draining an armature which has just been lifted out of the degreasing tank

operators are removed before they can get out into the shop.

Since parts are degreased without preliminary scraping, a large amount of sludge falls into the tank. The greater part of it is caught on a horizontal plate placed over the heating coils. The remainder of the grease and dirt goes into solution, and is deposited on coils and other parts of the tank. This necessitates cleaning the tank about once a week (once for every eight motors).

The cleaning operation consists of first removing the plate and the electric heating coil at the bottom of the tank. The coil is replaced with a spare which has been cleaned while the degreaser was in service, and the sludge plate is scraped and replaced.

Before the sludge plate and heating coil are removed, the dirty solution is pumped into a 125-gal. tank. While the tank is being cleaned, the solution is put through a still into another 125-gal. tank. To supply clean solution for cleaning the degreasing tank, there is a 25-gal. tank filled with clean solution. While the degreasing is in progress, this tank is filled by condensate which drips from the cooling coils near the upper edge of the tank. The condensate is caught in a gutter placed immediately below the cooling coils which carries the solution to the 25-gal. tank.

The arrangement of tanks, pipes, valves, still, pump and flushing hose is shown in the diagram.

Cost of Cleaning

The costs of cleaning by the old and the new methods are shown in the table:

Old Method	
55 gal. cleaner	$5.50
4 hr. labor at $1.05	$4.20
8 hr. labor at $.79	$6.32
Total	$16.02

Degreaser	
6 gal. Tetra	$7.50
1 hr. labor	$1.05
½ hr. labor (or ⅛th of time required to clean tank)	$. 53
Total	$9.08

This shows a reduction in cost for the vapor method even though all of the spray cleaning solution could be reclaimed at no cost. Added advantages for the vapor method are a reduction in the time the motor is held out of service, a better cleaning job, and effectively dehydrated coils. The vapor method requires the use of all synthetic varnish, but this in itself is probably an improvement which will soon be generally adopted.

The Carryphone Takes a Bow

(Continued from page 676)

to Carryphone or train, 2 to 3 miles and Carryphone to wayside station, 10 to 15 miles.

The Carryphone apparatus is installed in the cabin car for the use of the train crew. When placed in the receptacle provided for it, the batteries of the Carryphone are automatically connected with the batteries serving the larger trainphone system; thus, the Carryphone is always charged and ready for service.

The operation of the Carryphone is in no wise dependent upon the trainphone apparatus on adjacent cabin cars and locomotives. It works as an independent unit of the trainphone system; in fact, an employe with a Carryphone may drop off of a train anywhere, and while the train proceeds, he may communicate with wayside stations and his train and other trains in his vicinity.

The Carryphone is suspended at the side of the operator by a shoulder strap, the telephone hand-set being thus readily removed and replaced while walking or standing. To use it, all that is necessary to establish contact with a station is to remove the telephone hand-set from the side of the cabinet and broadcast the name of the station called. When the station responds, telephone conversation is conducted by the push-to-talk method, similar to the trainphone on trains. Carryphone works satisfactorily up to about 100 ft. from pole lines.

Train crews find the Carryphone to be a convenient tool, and use it frequently. For example, a hot box on a car in the middle of a train having been reported to the conductor and engineman of a train by trainphone, it was agreed between them on the trainphone that the train should be stopped at once, and the conductor make an inspection. The conductor taking the Carryphone with him, found the condition of the journal such as to require the car to be set off, and so advised the engineman directly on the Carryphone. The car was set off, train reassembled, and it was able to proceed without delays which otherwise would have been incurred without this newest method of communication.

A number of instances have occurred where the conductor of a freight train, after conversation on the trainphone system with the engineman of his train, and wayside station, or with other trains in the vicinity, has found the Carryphone to be of great assistance in taking care of unusual conditions. The delays resulting from unforeseen adverse circumstances or unusual conditions are minimized by the use of the Carryphone in planning and carrying out work involved.

Electrical Section Reports on

Air Conditioning and Radio

Car air conditioning report indicates use of many improved methods and devices – Radio report shows agreement on facts and differences on procedure

Two reports of the Electrical Section, Mechanical Division, A. A. R., respectively, on Car Air Conditioning Equipment and Application of Radio and Communication Systems on Rolling Stock are summarized in the following paragraphs. All other reports of both Electrical Sections were covered in the November issue of *Railway Mechanical Engineer*. To give all of them the attention they deserve and still keep within space limitations, it was necessary to hold these two reports over to this issue.

Car Air Conditioning Equipment

Concerning the development of new equipment, this report states that in cars where smoking is permitted, some means must be provided to remove the smoke and attendant objectionable odors, or otherwise provide space where smoking is permitted. One road has installed a modified ventilation system for a chair car which eliminates exhaust fans and uses a common filter bank for both fresh and recirculated air with automatic control of fresh air.

In kitchens, the report states that the trend is to provide separate ventilating systems completely independent of his air conditioning system. One road has a dining car in which all air is exhausted through this kitchen and auxiliary fresh air is brought into the kitchen. Air is directed across the crew and through the kitchen over the stove tops, removing heat effectively and keeping kitchen odors out of the dining space.

Concerning developments now in progress, the railroads and manufacturers have placed particular emphasis on the improvement of basic units as follows:

1. Develop equipment that will produce more uniform control of both temperature and humidity within the cars. (This item covered under separate Assignment No. 3.)
2. Design equipment for both overhead and under car units to reduce weight and provide smaller overall size.
3. Rearrange the component parts of the several systems to speed up and improve the efficiency of the men doing the servicing on the equipment at stations and terminals where the layover is short and also provide for simpler handling of shop overhauling.
4. Development of new basic units to provide air cooling, unlike any now in general use.

Concerning new developments, the report further states that the manufacturers are taking full advantage of the various new materials developed during the war period in designing of evaporators, heating units, condensers, fan housings, etc. Through research they have determined that reductions are possible in evaporator and condenser coil surfaces permitting the use of smaller and lighter units and still obtain the tonnage capacity required.

A specific example of such improvements is doing away with this so-called "package-unit" for electro-mechanical air conditioning and using instead this three-piece system consisting of an overhead evaporator unit, a separate condenser unit and a separate compressor-motor unit.

Another recent development is the rotary inverter for supplying a. c. power to the car. (This will be described in detail in a later issue of the *Railway Mechanical Engineer*.)

Electronic Filters

The report describes three electronic air filters made respectively by the Westinghouse Electric Corporation, the American Air Filter Company, Inc., and the Raytheon Manufacturing Company. (The Westinghouse units were described in the February, 1945, and February, 1946, issues of *Railway Mechanical Engineer* and American Air Filter unit in the November, 1945, and July, 1946, issues.)

One of the Raytheon units is described in the report as follows:

"It is designed to clean 2,250 cu. ft. of air per min. Of this air about 500 to 600 cu. ft. are drawn from the outside through the fresh air intake, fan, and mechanical pre-cleaner into the plenum chamber. In the plenum chamber the fresh air is mixed with air recirculated from within the car to make up the 2,250 cu. ft. of air per min. From the plenum chamber the air is drawn through the ionizer of the Precipitator where the air-borne particles receive a positive electrostatic charge, and passes on through the collector cell plates where the positively charged particles are attracted to and collected on the negatively charged plates. The cleaned air is then drawn through the cooling unit by the fan and circulated throughout the car by the clean air duct and its distribution system."

The typical system, described above may be mounted in the top of the car near the vestibule. The actual installation location, of course, should be determined by the design features of the car in which it is to be used. Dimensions shown are approximate to give an idea of space requirements. It would be necessary that access space be available for removing the Precipitator for periodic cleaning. If desired a custom built unit could be designed with an automatic or semi-automatic cleaning mechanism as an integral part of the unit.

The size of the power pack for supplying the high voltage requirements for the Precipitator for railway use would be such as to occupy about one cu. ft. of space. It consists essentially of a voltage doubler circuit using two Raytheon type 3B24 rectifier tubes, delivering 12,000 volts direct current to the ionizer and 6,000 volts d. c. to the collector plates. Suitable control, indicating, and protective devices are built into the power pack.

A patented ionizer-collector cell combination is also included herein. Because of its unique design and construction it is possible to effectively create a suitable ionizing field with voltages of 6,000 volts plus (above ground) and 6,000 volts minus. This enables a minimum of space to be used for the ionizer and collector cell assembly, as insulation requirements are reduced from those for the usual 12,000 volts above ground. It also reduces the space required by the power pack for the same reasons.

Where an existing air conditioning system is now installed and it is desired to add Precipitator equipment for the removal of the fine dust and smoke particles, the Precipitator ionizer-collector cell combination and the power pack may be purchased separately. In this way, the utmost may be made of existing equipment and the minimum of new equipment will have to be obtained.

It is generally agreed by the committee that air cleaning by electrostatic devices is probably the most effective means yet developed for this purpose. The installation costs at this time are quite high in comparison with other car accessories, so much so as to question the advisability of installing a unit capable of providing the degree of cleanliness obtained from this device. It may be justifiable from the standpoint of longer life in the upholstery fabrics, draperies, and other decorative materials now being used in the modern post-war cars.

Temperature Controls

There are three classes of control for heating in general use, namely, "Low, Medium and High," "Stepped" and "Cycling Modulations"; similarly for cooling there are two systems, namely, "Low, Medium and High" and "Modulated." The report analyses these as follows:

The conventional "Low, Medium and High" type of control is objectionable in either a heating or cooling system, as it is conductive to rather wide temperature variations in the passenger

zone due to "drifting"; it is uneconomical as more heat energy is expanded than necessary and, in the case of cooling, the humidity is substantially increased during the "Off" cycle. Therefore, serious consideration should be given to the replacement of this type of control.

"Stepped" control of heating is predicated on utilizing the overhead heat of the modulated type as the base heat and bringing in the floor heat thermostatically in steps, as the outside temperature continues to drop. In this manner, there is a continuous supply of the proper amount of heat to meet the demand and insure uniform temperature in all areas of the car.

"Cycling Modulation" of heat control is predicated on supplying a number of impulses of steam to the heating system. During mild weather, these are frequent short impulses but as the outside temperature becomes colder, the impulses are increased in duration, thereby increasing the supply of steam to meet the demand. To insure more uniform temperature conditions, the area of the car may be zoned with separate control for each zone, or the surface on one side of the car may be controlled independently of the other side to compensate for differences in sun's effect.

With "Modulated" cooling control, the compressor runs continuously and the cooling effect is adjusted to suit the demand, either by varying the compressor motor speed or by "cutting in" and "cutting out" compressor cylinders. Both methods are in general use, although the method of cylinder unloading may result in slightly more machine vibration on light loads than the other method. It is also necessary with "modulated" cooling to sectionalize the surface of the evaporator by providing separate expansion valves for each section and installing a solenoid valve in the liquid line to one section, so that closing of this valve reduces the active surface. A low-limit thermostat is also needed to cut off cooling in mild weather in the event of thermostat difficulties.

Concerning humidity control, the report indicates that with a considerable number of passengers in the car, the addition of moisture is seldom necessary during the heating season and may be objectionable in extreme cold weather, because of sweating of the walls and windows. Reheating is referred to as the best means of obtaining humidity control in the cooling system.

Special reference is made to "By product heat", "Indirect heat" and "Radiant heat".

By-product heat is such as may be obtained from internal combustion engine jacket water. Indirect heat is that in which a heat transfer system is used to heat a circulating medium which distributes heat throughout the car. Radiant heat is that which is derived from heating the wall surfaces and possibly the glass surfaces of the windows.

Concerninng the need for uniformity and simplification of controls, the report states that serious consideration should be given to the simplication of temperature controls for two reasons, namely, ease of handling in interline service and to eliminate as far as possible failures due to the human element.

With the advent of coast-to-coast movement of air-conditioned cars, it is rather difficult to train all the crews on the foreign lines in the handling of the various switches. Frequently, there are reported failures which later prove to be caused by improper setting of the switches. It is therefore desirable to consolidate the temperature control in a single switch having three positions, i. e., "Day, Off, Night". The selection between cooling and heating can be accomplished with thermostats in the fresh air stream. The day and night settings are necessary for two reasons, first, the night setting should be slightly higher than the day setting, because when coach passengers are sleeping, their metabolism is decreased so that, for a feeling of comfort, the temperature should be increased, and, second, in the event of a failure of any of the apparatus on the day position, the night position can be used for emergency protection.

Filter Fires

Concerning recommendations for instructions relative to discontinuing the air circulating fan in the event of fire, the committee is divided in opinion on the advisability of issuing such instructions. This constitutes an admission as to defects that exist in the system and thereby in the event of fire introduces a legal angle.

It is the committee's profound opinion that the best preventative of fire in air conditioning filters is cleanliness. Weekly cleaning of filters will eliminate the hazard.

Elimination of Odors

The report refers to several types of liquid deodorants which have been marketed stating that these were either of the "perfumed" masking type or the desensitizing type that deaden the olfactory nerves, thereby affecting the sense of smell. There was likewise produced several devices that seemed to eliminate odors through the process of "ozonating" or "ionizing" the air. These methods appeared to aid in the control of odors, but they are not producing the effectiveness necessary and desirable.

After considerable experimenting and checking of results, railroad air conditioning engineers recognized the fact that the most effective means of odor control was to provide adequate ventilation.

But if fresh air must be exclusively outdoor air, the conditioning load it imposes becomes prohibitive. In recent years, however, a practical solution to this problem apparently has been found. It is purifying and converting recirculated air to fresh air in an amount that is sufficient to make up for the ventilation deficiency, but without increasing the conditioning load.

There is still much popular misconception about what constitutes "fresh air" and the necessity of outdoor air as a means of supplying oxygen. The ASH&VE guide has this to say about oxygen requirements:

"Contrary to old theories, the usual changes in oxygen and carbon dioxide are of no physiological concern because they are too small to produce appreciable effects even under the worst conditions of normal human occupancy. Only in such unusually airtight enclosures as submarines and some air raid shelters need the increase in carbon dioxide and the reduction in oxygen be considered."

The amount of outdoor air that is ordinarily provided in a railway car is more than ample for oxygen replenishment. The need is not for more oxygen but for fresh air, that is, air that is uncontaminated or free of odors. Research conducted by the Navy proved that an air supply of one cu. ft. per min. per person supplies more oxygen than is actually needed. Air is stale when it has an accumulation of odors, but not because it lacks oxygen. In other words, air is not really bad, it only smells bad.

Air purification by carbon is a fairly recent development in air conditioning. (It was described in the July, 1946, issue of *Railway Mechanical Engineer.*)

Reference to odor elimination in this report is concluded with the statement that to date, this method of odor control seems to give the most promise of effectiveness.

Mechanical Refrigerators

For the purpose of food preservation the report states that mechanical refrigeration can be used to replace ice in the preservation of food in dining cars and buffet sections of lounge or observation cars. From a design and operation standpoint, it is desirable to use floor-mounted rather than overhead refrigeration units, as the former location is not only readily accessible for inspection and adjustment of apparatus but there is no danger of dirt or cinders leaving the compressor and accumulating in the evaporator with resultant damage to the compressor.

It is desirable to employ individual refrigeration units rather than a "multiplex" system for two reasons: First, in the event of failure of one unit, the commodity can be transferred to another refrigerator without loss of food, and, second, where there is an appreciable difference in the temperatures of the commodity spaces, there is difficulty in balancing the two systems; also, in the event of sudden loads in either refrigerator, there may be unsatisfactory temperature conditions until the compressor operation has satisfied the load.

Ice cream and frozen foods should be carried at a temperature of approximately 0 deg. F to plus 5 deg. F and meat and other foods at approximately 35 deg. F to 40 deg. F.

The evaporator should be of the blast type to insure uniform air circulation through all zones of the commodity space.

Where beverage cooling is required, the bottles should be placed on suitable racks beneath the outlet of the blast type evaporator.

It is very important that the electrical load be reduced to a minimum and to accomplish this end the refrigerators should be provided with approximately 5 in. thickness of insulation in the walls.

On the floor-mounted refrigeration units, when the condenser cooling air approaches large quantities, it may be necessary to provide floor openings at the larger units to admit outside air and arrange vertical ducts for the discharge air and install a

Diners offer the maximum possibility for the use of electrical equipment and also offer the greatest problems

small roof-type exhaust fan and roof ventilator on the duct. The intake duct should be provided with intake grille and multiple damper, which can be closed in Winter time or a steam coil may be used to temper this incoming air to insure satisfactory operation of the condenser.

Consideration has been given by several of the railroads to the use of a. c. energy for the operation of these refrigeration motors and thus eliminate the brush and commutator troubles inherent with d. c. motors in this service.

The freezing of ice cubes can also be arranged but the capacity of the refrigerating unit must be materially increased, thereby adding a heavy load on the electrical generating unit. Probably a more economical and flexible arrangement is to utilize cracked ice obtained from cakes of artificial ice carried in a separate refrigerator.

Relative to drinking water cooling the report specifies that units for coach service should have a capacity of approximately three to four gal. per hr. cooled from 80 deg. F to 50 deg. F with an ambient air temperature of 90 deg. F on the cendenser. On dining cars, this capacity should be increased to approximately 15 to 16 gal. per hr. and the unit arranged as a tank type cooler with two or more pressure type faucets.

The report is signed by S. G. Peterson (chairman), superintendent car department, Seaboard Air Line; P. J. Callahan, electrical foreman, Boston and Maine; G. E. Hauss, electrical supervisor, Baltimore and Ohio; A. E. Voigt, car lighting and air conditioning engineer, Atchison, Topeka and Santa Fe; J. L. McMullen, electrical inspector, New York Central; W. J. Madden, electrical foreman, Pennsylvania; W. A. Woodworth, general inspector air conditioning and car lighting, Southern Pacific; G. F. Schaffner, general air conditioning supervisor, Chicago and Northwestern; D. F. Carter, assistant electrical engineer, Chicago, Burlington and Quincy; C. E. Foutz, assistant superintendent of yards, The Pullman Company.

Discussion

Following the presentation of the report, the Committee Chairman added that designs have been made which simplify the cleaning of Precipitron filters. A manufacturer's representative explained that the problem involved is to design a filter which can be placed in the space available. He added that in the Milwaukee car, cleaning is done automatically every eight hours, a procedure which avoids an accumulation of dirt on filter parts. The car, he said, is remarkably clean, that passengers comment on its cleanliness, and that cleaners going to work do not think the car has been in service. He also said it eliminates odors and all tobacco smoke. Questioned about the elimination of odors, he added that the car is equipped with Steri-lamps which produce a small ozone and that this may contribute to lack of odors.

A question concerning direct humidity control received the reply that this requires reheat. Supplementing this statement, it was reported that the Santa Fe conducted a test on humidity control with steam ejector equipment, in which the temperature of the cold water pump is used as a control. With this arrangement, the system may start, under some conditions, when the car thermometer does not call for cooling; this requires a limiting device. With this control system, the user states, the car stays well within the comfort zone.

Another case was reported in which reheating was done by means of Freon with a hair-type humidistat used for control, but that this was constantly in trouble. The system used reheat but had a capacity of only 7 tons and this was not enough.

Attention was called again to the Milwaukee Diesel-powered car which does use a humidistat and for which the relative humidity is maintained to 1 or 2 per cent. Mention was also made of a room car having a thermostat in each room, cool air being carried in the car ducts and thus brought to proper value by reheat. Reheat, it was claimed, is better than a humidistat for obtaining comfort. It was also stated that in cars with unit power plants on the Burlington, jacket water is used for reheat.

The Baltimore & Ohio has one train equipped with humidstats in which the equipment is run continuously with the compressor slowed down, when the demand for cooling is low. The operator added that the hair-type humidistat used is very delicate.

The question of possible filter fires raise several questions,—namely,—should the blower fan be stopped,—should it not be stopped,—should its operation be made automatic by photo-electric cells or by fused link,—or by instructions to train crews, and to what extent may the activated carbon filter contribute to fire started in the filter. The consensus of opinion indicated that clean filters were best insurance against fires and that the question should be considered jointly with the Safety Committee.

Considering the elimination of odors, a railroad user stated that activated carbon does definitely remove odors and that no other means approaches this method of air purification. It was also said that masking chemicals were ineffective for odor elimination but that cleaning of filters and plenty of fresh air were of first importance.

Application of Radio and Communication Systems to Rolling Stock

During the past year the Committee on Application of Radio and Communications Systems to Rolling Stock has been represented at all meetings of Committee 4, Radio and Allied Communications as Applied to Railroad Operations, of the communications Section. Committee Four also functions as Committee No. 7—Railroads Radio Communications Services, Panel 13, Radio Technical Planning Board.

Practically all of the work of Committee Four this year has been along lines outside the sphere of interest of the Electrical Section so no report on these meetings has been included in this report.

As information, the report includes rules governing employees operating radio communication equipment on rolling stock. These were taken from a pamphlet presented by the communications Sections and are not reproduced here.

A list of railroads which are actively engaged in testing train radio or inductive communication equipment or which are proceeding with permanent installations is given as follows:

Railroad	—Inductive— Yard or terminal	Road	Radio
Atlantic Coast Line	..	X	..
Atchison, Topeka & Santa Fe	..	..	X
Bessemer & Lake Erie	..	X	..
Baltimore & Ohio	..	..	X
Chicago, Burlington & Quincy	X	..	X
Chicago, Milwaukee, St. Paul & Pacific	..	..	X
Chicago, Rock Island & Pacific	..	..	X
Denver & Rio Grande Western	..	X	X
Florida East Coast	..	..	X
Gulf, Mobile & Ohio	..	..	X
Great Northern	X	..	..
Jacksonville Terminal Co.	..	..	X
Louisville & Nashville	X	..	..
Missouri Pacific	..	X	X
Norfolk & Western	X	..	..
New York Central	X	X	X
Northern Pacific	..	..	X
Pennsylvania	X	X	..
Pere Marquette	..	..	X
Seaboard Air Line	..	..	X
Terminal R. R. Assn. of St. Louis	X	..	X
Union Pacific	..	..	X

Passenger Car Train Line Circuits

The rapid increase in use of inter-car train line circuits for purposes of entertainment or communication in recent years brings about a need for standard plugs and receptacles to connect adjacent cars in a train. The growth of interchange of cars, as more through routes are established, further accentuates this need.

Past experience with many different receptacles was reviewed and the conclusion reached that none met all requirements of this particular service.

An analysis of the many various opinions on this subject was made by the committee which then drew up tentative specifications which are published in the report. They are not included in this abstract since they were prepared for the purpose of giving direction to further work by the committee.

Power Supply

On December 11, 1944, Committee of the Communications Section, A. A. R. (J. L. Niesse, Chairman), met with the various manufacturers of radio and carrier type communication equipment, to which meeting this Committee was invited. Unanimous agreement was there reached between the communication manufacturers and Committee 7, that 117 volts, 60 cycle, single phase, alternating current is to be the standard to which radio and carrier type communication equipment for railroad use will be built. The committee has worked entirely in accordance with this decision in developing the various methods of providing power for the communication equipment.

Investigation of existing installations indicated that the average standby load is 120 watts continuous and the transmitting load is 347 watts intermittent.

Performance records showed that the communication equipment is in service only 2.28 per cent of the total time between terminals, but in arriving at generator and battery sizes the committee used 5 per cent of the total time, which should amply cover any operating situation.

Steam Locomotives

The steam locomotive presents no particularly difficult problems in providing 117 volt, single phase, alternating current, and the several ways in which this can be accomplished are set forth below:

1—Apply additional turbo-generator to supply 117 volts, single phase, alternating current power, which would be used for communication equipment purposes only and be entirely independent of the present d.c. turbo-generator. This is a very desirable method if the present dynamo on the locomotive is of insufficient capacity to handle the additional load. It offers another distinct advantage in that the a.c. generator can be of considerably less capacity than a d.c. machine used for the same purpose as no conversion losses need be considered and no heavy starting currents incident to rotating converters are involved. The committee estimates that a 500-watt, 117-volt, single-phase, a.c. turbo-generator is sufficiently large to supply current for any of the communication equipment listed. The only serious disadvantage of such an arrangement is that two turbo-generators must be maintained instead of one, with the consequent increase in maintenance expense. However, the committtte definitely recommends this type of power supply where the present turbine is of insufficient capacity to absorb the additional load. The estimated cost of providing this type of power supply, including new turbo-generator, mounting bracket, piping, power wiring, circuit breaker, and antenna mounting plate is $360.00 per locomotive. This includes labor, but no overhead on either labor or material.

2—Use dual voltage turbo-generator to replace present turbine. Such an arrangement can be used to best advantage where the present d.c. turbo-generator is too small and it is not desired to incur the additional maintenance expense incident to using two turbines. One company is now developing dual voltage machines to deliver 32-volt, d.c. and 117-volt, single-phase, 60-cycle, a.c. power. While no actual operating data is available on dual voltage turbines for locomotive use the committee feels that such machines should not present any problems in actual service. The estimated cost of providing a new dual voltage turbine together with such other items as wiring, mounting bracket, circuit breaker, and antenna mounting plate is $460.00 per locomotive.

3—Use present 32-volt, d.c. turbo-generator with conversion equipment to provide 117-volt, single-phase current. To consider using this arrangement it must first be determined that the present d.c. generator is of sufficient capacity successfully to absorb the increase in load. Not only must the generator have the necessary wattage capacity, but it must also have sufficient reserve to handle the starting current if rotating type conversion equipment is used. Such starting currents are often 300 per cent or more of normal running current, especially with dynamotor type converters. A 1,000-watt d.c. generator is the minimum capacity which the committee considers it possible to use successfully with this power supply arrangement.

The voltage regulation on most rotary converters, except those built with compensating fields, and which are inherently self regulating, is none too good. This is not serious on locomotives where the input voltage is fairly constant, but should be carefully considered and investigated if this type of conversion equipment is to be used on cabooses equipped with axle generators. Most rotary converters have sufficient capacity to absorb at least 50 per cent overload for short periods, and the committee feels that any well designed converter of 300 watts rated capacity which has the proper voltage regulation will be satisfactory for any of the communication equipments listed.

Another type of conversion equipment is the so-called electronic inverter, such inverters are of the vibrator type and one manufacturer states that their inverters can maintain a steady output voltage of 117 volts with d.c. input voltages varying from 22 to 48 volts at any load within the capacity of the inverter. The efficiency of the vibrator inverter is about 72 per cent throughout the greater part of the load range, although some manufacturers claim approximately 80 per cent efficiency. The efficiency of the inverter is somewhat higher than that of rotating type converters, which rarely have an efficiency of more than 50 per cent.

One advantage of vibrator type inverters is that they have no rotating parts and are considerably lighter than the rotary type. They have been successfully used on aircraft and should be satisfactory if proper care is used in selecting the inverter equipment. The cost of the vibrator inverter is considerably less than any of the rotating types.

The estimated cost of applying power supply equipment of the converter type using the present direct current turbine is as follows:

Conventional non-self regulating rotary converter	$232 per loco.
Self regulating type rotary converter	302 per loco.
Vibrator type inverter	185 per loco.

The above costs include power wiring, mounting brackets, circuit breakers, etc.

The committee recommends that all communication equipment be installed on the locomotive proper if possible. This will eliminate connections between engine and tank, and also long power leads and considerable conduit work. The committee realizes that this will not always be possible and that each class of locomotive will present different problems in locating the communi-

Train communication has come to stay — and best means for supplying necessary power must be worked out

cating equipment and therefore, made no other recommendations than the above concerning the location of equipment.

The committee recommends that an entirely separate conduit system be provided for the alternating current and radio frequency circuits.

When locating antenna and other equipment on locomotives it must be remembered that standard railway clearance diagrams do not always reflect the minimum clearance under which the antenna must pass. Height of roundhouse doors, coal chute and water crane clearances must also be considered.

In considering the application of 60-cycle alternating current on locomotives the possible interference with 60-cycle train control equipment should be carefully investigated on railroads where such train control equipment is used or contemplated. It is the opinion of the committee that the possibility of interference exists and might become serious, should the frequency of the alternating current communication equipment circuits on the locomotive be within the range of 57 and 63 cycles producing a beat frequency which might result in a false clear cab signal. The train control grid circuits are very sensitive and may possibly pick up stray 60-cycle currents from the communication equipment.

Diesel Locomotives

At present, Diesel locomotives in service have auxiliary power at 32, 64, and 112 volts direct current. The future will probably see the 112 volt equipment die cut as there is a trend toward standardization on 64 volts, though 32 volts may continue in use on small locomotives.

Auxiliary power is obtained from a generator driven by the prime mover and is normally at about 37, 73, or 128 volts. Voltage variation is not so extreme as with axle driven generators because the prime mover is usually operating when the locomotive is in service and communication will be required. However, the need for communication when the prime mover has failed should be considered and operation should be satisfactory at the lower voltage.

Builders of Diesel locomotives were queried as to capacity of auxiliary power supply to handle a communication load at 600 watts continuous and 1,000 watts transmitting.

The replies received indicated that road locomotives have ample capacity while most switches have little or no exctss power.

In general, there appear to be no particularly difficult problems in application of communication equipment to Diesel locomotives. The power requirements should be reduced as developments continue, permitting application to locomotives with little excess auxiliary power.

Estimated cost of providing power supply equipment on switch engines and single-end road engines is $250.00 per locomotive and on double-end road engines $400.00 per locomotive.

Cabooses

The caboose presents the most difficult problem of all for which to provide an adequate and reliable source of power for communication equipment.

After determining the load for which power would be required it was necessary for the committee to study a variety of through freight train operations in various parts of the country to determine the hours of caboose service and average caboose speeds, and obtain other data which would influence the amount of power required and that which it would be possible to obtain from an axle generator.

There was such a wide variation in length of caboose runs, hours of service, and speeds, that the committee finally adopted the A. A. R. figure of 20.2 miles per hour as the average caboose speed and assumed that 16 hours would be the maximum time any caboose would be on the road between terminals where maintenance attention was available. On this basis, sufficient equipment for a period of 16 hours' operation is recommended, even though the caboose is equipped with an axle generator. This would provide protection in the event of belt or other generator trouble immediately after leaving terminal.

The choice between equipping cabooses with axle generators or relying on storage batteries charged at terminals must necessarily lie with the individual railroad and be dependent upon the character of caboose operation. Generally speaking, cabooses on long runs will be mostly self-sustaining electrically if equipped with axle generators.

On short runs the straight storage system will probably prove entirely satisfactory.

Generating capacity in some form must be provided for all applications. Whether this is in the form of larger units at terminals or smaller axle units on cabooses can be decided only by the individual railroad involved, after carefully weighing initial and operating costs and all operating conditions.

One of the major disadvantages of depending entirely upon storage batteries without axle generators is that it will be necessary to switch cabooses to predetermined tracks where charging facilities are available and leave them on charge a sufficient length of time to assure the battery being fully charged before departure.

The primary current on cabooses must be direct current. After carefully considering all of the factors involved, the committee recommends the following as being the minimum generator and battery capacity to successfully meet the requirements of communication equipment on caboose cars:

Axle generator capacity	2 Kw.	
Axle generator voltage	40 volts d. c.	
Axle generator full load speed	400 r. p. m.	When any conventional belt drive is used
Axle generator maximum speed	2,240 r. p. m.	
Storage battery capacity	16 cells, lead, or 25 cells, Edison 224 amp.-hr., rated at 8-hour rate. This is equivalent to 280 amp.-hr. at 16-hour rate.	

For axle generator shaft taper, generator pulley and axle pulley specifications the committee recommends those included in the Electrical Sections Manual of Recommended Practice, revision of 1939.

A much smaller, lighter generator of equivalent capacity to the above could be developed if the speed were increased as this would be entirely feasible if the generator were driven with direct mechanical drive such as the Spicer. With this arrangement the full load generator speed could be approximately 1,000 r. p. m. and the maximum speed 4,000 to 4,500 r. p. m. The relation of generator speed to car speed would be determined by the drive gear ratios.

One company has designed a new and unique generator equipment for caboose power, utilizing a belt driven, gear-in-head induction alternator driven from caboose axle by means of conventional belt drive. The alternating current is passed through a selenium type fan cooled rectifier, converted to d. c. then through cut-out relay to storage battery. Thus the frequency of the alternator is not important and the machine has the advantage of having no armature winding and a very simple field arrangement. None of these equipments are in actual operation and the committee, is, therefore not in a position to comment on its performance.

A third possibility of providing power is from a small internal combustion engine, direct connected to either an a. c. or d. c. generator and mounted on the caboose, either inside or outside. Should such a generator be used to generate single phase alternating current of the proper voltage, no storage battery would be required except possibly a starting battery, which could also be used for field excitation and all of the problems incident to terminal and road charging of such batteries would be eliminated. Of course, such an arrangement provides no protection in the event that the generating unit is disabled. The possibility of fire hazard is also present whenever gasoline is used as fuel. The possibility of using internal combustion engines for this service should be thoroughly explored as such engine generating units have been developed to a high state of reliability. Such units were used during tests on the D. & R. G. W. and proved very satisfactory and reliable.

Should axle generators be adopted, the problem of how to drive such a generator immediately becomes apparent. The committee has investigated three drives which have been developed, namely: The conventional flat belt with body hung generators such as used on most passenger cars, a drive which utilizes endless "V" belts with idler pulleys, and a full mechanical drive.

The conventional flat belt drive can be applied to most caboose trucks, but will require redesigning the brake beam to provide axle pulley clearance as it is essential that the axle pulley be mounted near the center of the car axle. Such drives do not function well in ice and snow which must be considered when deciding on the proper generator drive. Also, the slack action on long freight trains may result in breakage of belt.

The drive developed, using the endless "V" belt, has proved successful on a number of applications driving a 400-watt generator, and the manufacturer assured the committee that it would be satisfactory to drive a 2-kw. generator. The drive can be applied to nearly all types of conventional caboose trucks without truck alteration and at a nominal expense.

No authentic records were available as to the actual belt life obtained with this type of drive.

The mechanical drive was designed for caboose service and is a modification of the passenger car generator drive developed by the same company. It requires a special journal box assembly and slight alterations to conventional axles. This drive offers some very interesting possibilities and the committee will investigate it fully and present its conclusion in a later report. None of these drives has been applied to cabooses to date.

With any type of d. c. generator it will be necessary to convert the d. c. to single-phase, 117-volt, alternating current for the communications equipment, for which purpose either a vibrator inverter or rotary converter can be used. These were discussed in detail under steam locomotives.

The estimated cost of equipping a conventional caboose with complete power supply equipment for operating a 117-volt, single-phase, alternating current communications equipment using any of the combinations discussed above is as follows:

With axle generator, lead batteries, non-self regulating converter, and all wiring	$1,311.00
With axle generator, lead batteries, self regulating converter, and all wiring	1,600.00
With axle generator, lead batteries, vibrator type inverter, and all wiring	1,270.00
If Edison batteries of equivalent capacity are used add $210.00 to the above.	
No axle generator, lead batteries, non-self regulating converter, and all wiring	801.00
No axle generator, lead batteries, self regulating converter, and all wiring	1,090.00
No axle generator, lead batteries, vibrator type inverter, and all wiring	760.00
If Edison batteries of equivalent capacity are used add $210.00 to the above.	

No cost figures have been obtained for the internal combustion engine generator type of power supply equipment, but these will be included in a later report.

Battery boxes located under cabooses should be exceptionally well braced to protect batteries from damage due to excessive slack action.

When any caboose is likely to operate in electrified territory with overhead trolley, some means of protecting the antenna from accidental contact with trolley must be provided. This can be done by using high voltage fuses and arresters in antenna circuit or by grounding the antenna at nodal points.

The problem of providing wayside battery charging facilities at terminals comes under the jurisdiction of the Electrical Section, Engineering Division, A. A. R., and the report of its committee on this subject is summarized with the other Engineering Division reports in this issue.

The report is signed by R. I. Fort, (*chairman*), mechanical inspector, Illinois Central; D. F. Dunsmore, assistant electrical engineer, Chesapeake & Ohio; F. E. Gould, equipment inspector, New York Central; J. P. Kivlen, engineer maintenance of way and equipment, Northampton & Bath; Roy Liston, mechanical inspector, Atchison, Topeka & Santa Fe; L. J. Varbarg, air conditioning engineer, Missouri Pacific.

Discussion

The primary topic for discussion concerned the question of communication connectors between cars on passenger trains, the only space for the necessary connector above the vestibule being 2½ by 3½ inches, and different railroads feeling that they want from 3 to 48 wires. The number of wires required depends upon what circuits are to be included, i. e., whether the train will be equipped with telephone, public address system, wired music and radio, with or without selector switches in car compartments. The maximum is that in which such facilities are used on all cars, and the minimum that in which only a part of them are used on a few cars. Consideration was given to put such connectors under the coupler but this was thought inadvisable because it placed one electrical circuit at a distance from the others, putting one inside and one outside the vestibule. It was also suggested that brake control and communication circuits might be put in the same connector, but this was ruled out on the ground of interference.

The question for the need of a standard was also raised since various railroads will use a different number of wires. It was thought, however, that standard positions could be given in the connectors to circuit wires which would be used by all roads. Most of the representatives present seemed to feel that 12 contacts would be sufficient and it was finally agreed that the committee proceed to develop a plug which will meet space requirements and will include as many contacts as practicable.

Under the subject of plugs and receptacles for radio and other appliances on cars, the report recommends standard receptacles for a. c. circuits and curved or round contact type receptacles for d. c. circuits. Following some discussion, these two recommendations were deleted, substituting one that standard receptacles be used for both applications, and that those having 110 volts be stencilled to indicate the voltage.

Discussion on caboose power supply revolved principally around a question of the supply voltage, i. e., whether it should be 12 volts or 32 volts d. c., or 170 volts, 60 cycle a. c. The desirability of having radio tubes with 32-volt heaters was expressed, but there appeared to be no unanimity of opinion concerning the matter of voltage supply.

NEW DEVICES

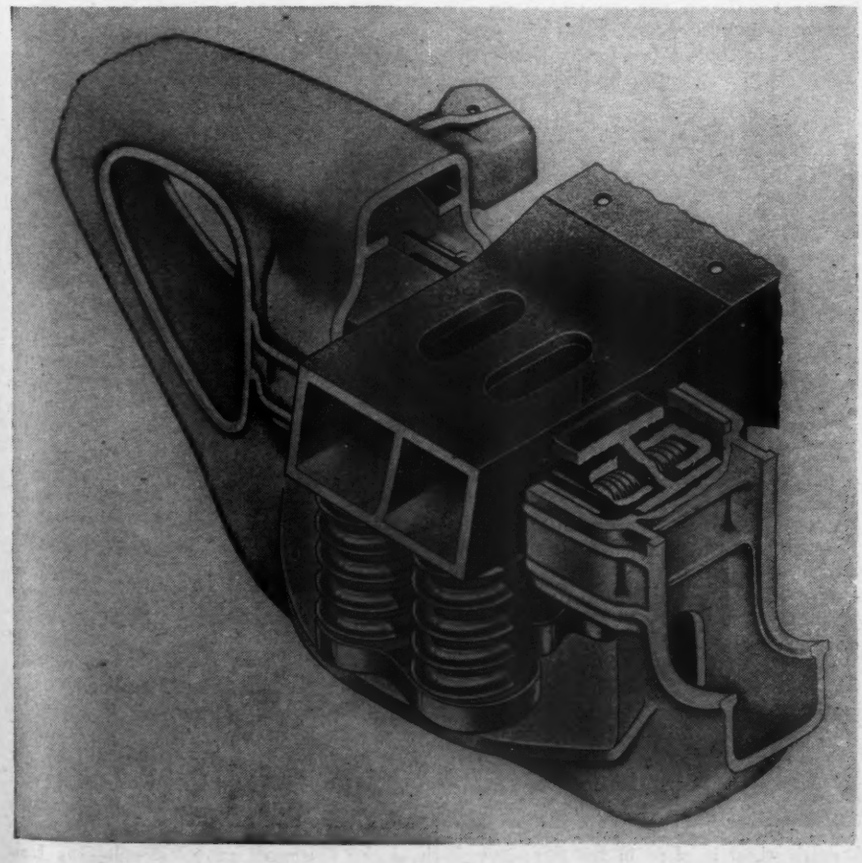
Freight Car Truck

The Scullin L-V truck cushions and controls both lateral and vertical motion, thereby helping to maintain constantly controlled truck alignment and reduce lateral impacts and lateral journal stresses. Lateral motion is resiliently cushioned by the built-in lateral springs which function between the side frame and the bolster. Vertical motion is cushioned and controlled by snubbing elements actuated by the lateral springs. Variable or constant frictional snubbing can be provided to control the action of the load-bearing springs.

The lateral box-shaped spring housings are cast integral on each side of the bolster at the side-frame location, and a vertical partition divides each housing into two sections for spring seats. The lateral coil springs are placed in each section, seated in a fixed position. Friction snubbing caps over the ends of the springs are inserted into the open end of the housing section and move freely in a lateral direction. Their outer surfaces contact hardened-steel wear plates, applied on the inner surfaces of the side-frame column flanges.

To assemble, the lateral springs and friction caps are inserted into their housings, and a standard bolt is applied laterally through the caps to compress the lateral springs sufficiently to permit the bolster to enter the side frame. The bolster is then raised to a position that will allow the removal of the assembly bolts, and the truck is assembled in the conventional way. To disassemble, the bolster is raised enough to remove the vertical springs, and then lowered sufficiently to apply the assembly bolts.

These L-V trucks are manufactured by the Scullin Steel Company, St. Louis, Mo. Their weight is said to be comparable to that of a conventional truck, and roller bearings can be applied if desired.

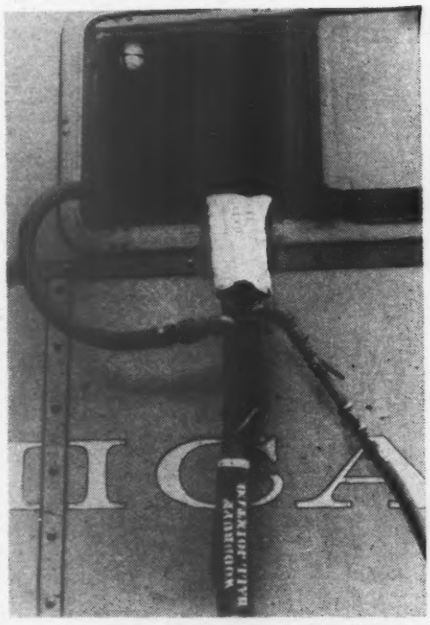


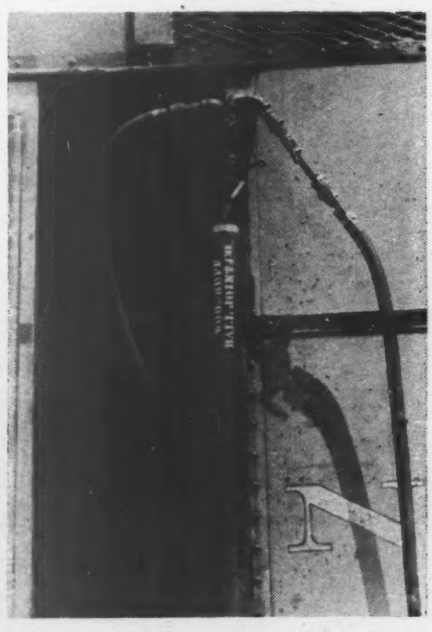
Cutaway view of the Scullin L-V truck showing the laterial and vertical control assemblies

Diesel Locomotive Cleaner

An antidote for fires on Diesel locomotives is good housekeeping and cleanliness not only in enginerooms but on underneath parts such as trucks, motors, fuel tanks, etc., where oil-filled dust and dirt accumulate. A vacuum syphon-jet cleaning system, non-electric, with no moving mechanical parts, that gets this dirt, oil, etc., quickly out of the electrical equipment and exhaust chambers has been developed by the Woodruff Ball Joint Company, Chicago.

This equipment uses a dielectric fiber tool, on an extra long shaped tube, to reach distant parts. It gets oil-soot accumulation out of the crank cases with a special steel-shaped tool. It is supplied with a neoprene rubber dust tube, to carry the dirt, etc., into a can or receptacle, outside the car. The equipment weighs little, is easily carried about and may be hung either on the window sill of locomotives or grab-iron rail at the door, as shown in the illustrations.





Woodruff vacuum-jet equipment may be suspended from a window or door grab rail while cleaning oily dirt accumulations from Diesel locomotives

The operation is by air pressure through inlet jets which convert the pressure into a powerful suction. This is a two-purpose system, since by turning the valve cock handle, the equipment will blow.

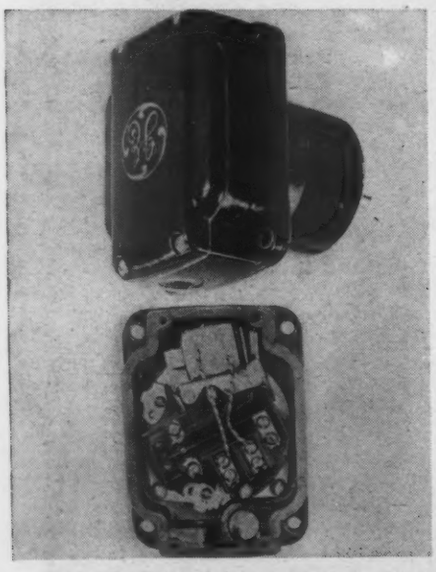
This device is easy to operate and maintain, saves labor hours, reduces fire hazards, and is ready to use in all kinds of weather.

Necessary assorted tools are supplied, also two lengths of 1 in. vacuum hose, an adapter hook and a neoprene rubber dust tube.

Plugging Switches

A line of oiltight and dustproof plugging switches for flange and surface mounting has been announced by the Control Division, of the General Electric Company. The new switches are designed to remive plugging power from a motor at the correct moment to keep the motor from restarting in the reverse direction. The flange-mounted form is for built-in applications, the surface-mounted type for general purpose use.

Contacts in the new switches are of silver, and can handle directly the coil current of a 150-amp. contactor. This eliminates the cost of interlocking relays on starting panels in most applications. Clean contact surfaces are maintained by the wiping action which results from the use of a spring-bronze contact strip. Adjustment of contact operating speed can be easily made by changing the tension of two springs with a screwdriver.



Two views of the flange-mounted switch, cover on and cover removed

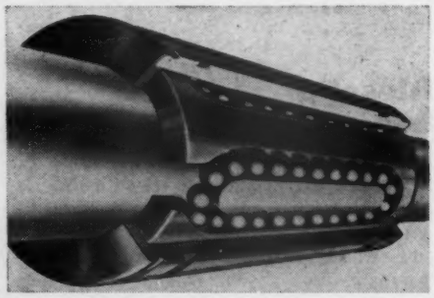
The switches are provided with grease-packed ball bearings for operating the shaft and magnet assembly. The Alnico magnet assembly with its operating arm provides the forces for operation of the contacts without the use of frictional parts or clutches, thereby reducing maintenance. As a guard against entrance of oil or dust, gaskets are used under the cover of the switch and around the shaft.

A lockout device can be provided which releases the lockout latch and permits normal operation of the switch when the motor is connected to the line. On applications which require turning over the driven machine by hand. the lockout device protects the operator by acting as a guard against accidental starting.

The maximum continuous rotating speed of the new switches is 1,800 r. p. m. Two sizes of springs provide for adjustment of contact operating speed over ranges of 40 to 140 r. p. m. and 140 to 750 r. p. m.

Ball Bushing For Linear Motion

To give linear-motion installations the same comparable advantages that have resulted from the application of ball bearings to rotary motion, a ball bushing has been developed by the Thomson Industries, Inc., 2905 Review avenue, Long Island City 1, N. Y. In addition to the reduction of wear, friction and maintenance afforded by all types of friction bearings, these bushings offer a solution to two problems inherent in the use of plain sliding bearings. The oil film over the exposed surface of the shaft, upon which the plain bearing's operation depends, deteriorates due to oxidation and becomes gummy and grit-laden. Plain bearings require a large length-to-diameter ratio, which can be reduced a sizeable amount by the free-rolling ball bushings.



The ball bushing for linear motion

This device is basically for anti-friction linear or reciprocating motions. Relative motion between the bearing and the shaft will cause the balls to slide with resulting wear. As a result, the standard design is not generally recommended for supporting a member that both rotates and reciprocates.

There are three or more oblong circuits of balls, depending on the shaft diameter, and each circuit has the balls in one of its straight sides in bearing contact between the inner surface of the sleeve and the shaft. The load is rolled along the balls in this portion of the track. The balls in the remainder of the circuit are free to roll in the clearance provided in the sleeve. A retainer is interposed between the sleeve and the shaft which guides the balls in the proper path and prevents their falling out when bushing is removed from the shaft.

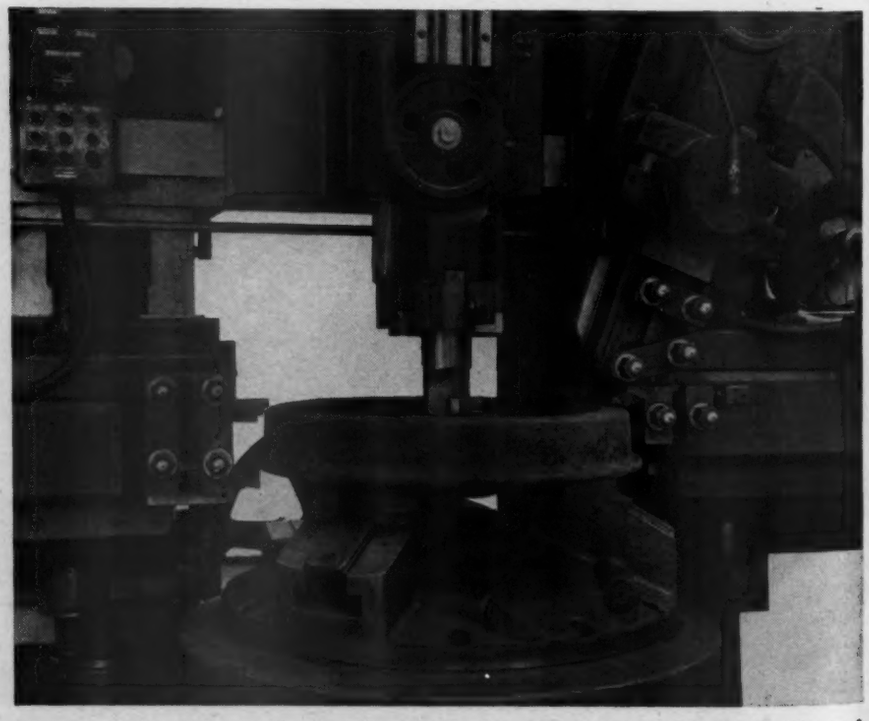
Round ball bushings are available for shaft sizes from ¼ in. to 4 in. Rated static load capacities vary from 22 lb. to 4760 lb., and rolling load capacities from 13 lb. to 4300 lb. Special shapes, such as square, angular, or oblong can also be furnished on an experimental basis.

Car Wheel Boring and Turning Mill

The Cincinnati Hypro Automatic Boring and Turning Mill for machining rolled-steel car wheels is designed to turn out accurate, well-balanced, highly finished wheels at the rate of approximately six wheels per hour. Some of the features of this machine include an entirely new wheel-chucking method, the machining of all parts of the wheel simultaneously, and the use of electroncially controlled thymatrol motors.

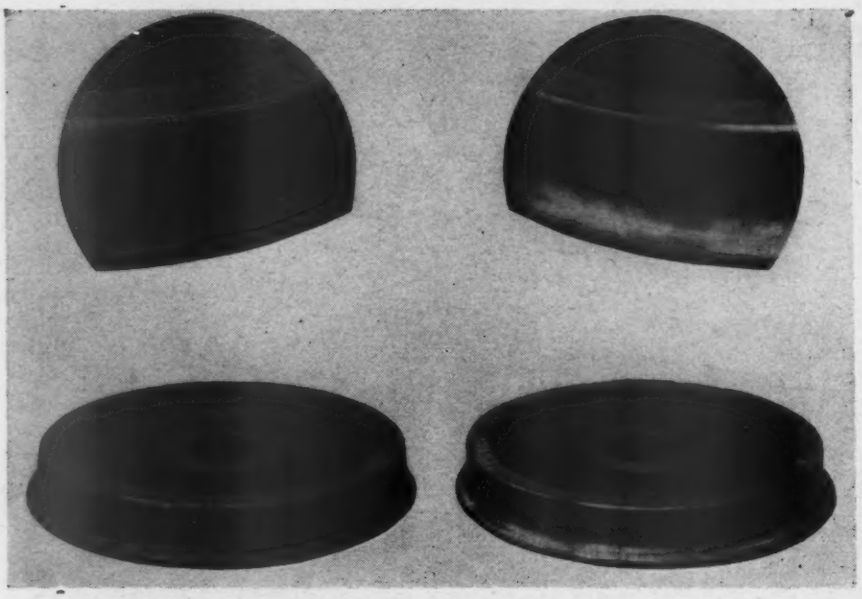
The chuck for holding the wheel in position on the table allows the hole to be free so that the boring of the center hole in the wheel can be done simultaneously with the rim, flange and tread. This arrangement centers the wheel so that after machining, the wheel is balanced in rim thickness. As all the jaws on the chuck are operated from one central lever, the time required for chucking is kept low.

The machine is fully automatic. The



A rough wheel in place in the three-jaw chuck of the Cincinnati car-wheel mill—The tools are in their starting positions

AMCCW
To all railroad men everywhere...
The Association of Manufacturers
of Chilled Car Wheels
wishes you a Merry Christmas 1946



The difference in finish on wheels turned by the plunge-cut method on the left, and by the contour-generated cut on the right

operator picks up the wheel with a hoist that is mounted on top of the machine. The wheel is lowered until it rests on the chuck seats, at which time the operator moves the lever which operates the hydraulic mechanism and the chuck jaws contact the wheel and lock it securely to the table.

At this time the operator presses the automatic button on the machine and the four heads, namely, the boring and facing head, the rim-turning head and the two side heads, all traverse in to contact the wheel. These heads then go into a feed change, feed through their operation, and automatically return to their starting position.

Carbide tools with high negative rakes are used for all turning operations, while the tools of the boring and facing head are of high-speed steel. All cuts are contour-generated to give finer finishes as well as greater accuracy.

From a glance at the illustration of the machine, the functions and locations of the various tools can be seen. The high-speed-steel tools for facing the hub and for boring the hole in the hub are contained in the boring-and-facing head. The upper tool on the right faces the rim; the lower tool rough faces the tread down to and half-way around the flange where it meets the lower tool on the left which faces the bottom and undercuts the back of the flange. Finish cutting of the tread is done by the center tool on the left, and the radius is cut on the tread by the tool on the upper left.

The boring and the rim-turning heads are equipped with thymatrol motors, electronically controlled, and are screw operated. Both side heads have General Electric contouring attachments for the taper and contour on the tread and flange of the wheel. The traverse and feed motion to all heads are obtained through electronically controlled motors mounted individually on the heads.

The machine is driven by a 100-hp. main-drive motor and has table speeds of 5 to 25 r. p. m. The complete machine is electronically controlled for lower maintenance and better operation. All gears and shafts are mounted in anti-friction bearings and are preloaded for greater accuracy. The hydraulic cylinder for operating the chuck is mounted on the bottom of the spindle under the bed of the machine.

The machine is arranged to take wheel sizes from 33 in. to 40½ in. inclusively, but can be furnished for other wheel diameters. It is a product of the Cincinnati Planer Co., Oakley, Cincinnati 9, Ohio.

Hot-Journal Alarm System

The Fenwal journal alarm is designed to detect an overheated box before serious trouble develops by giving a visible and an audible warning in the locomotive and in the car concerned. Unnecessary delay in locating hot boxes is avoided by the push buttons in the control panel for finding the bad box.

The journal alarm panel showing indicator lights, test buttons, and buttons for locating the defective box

The critical detecting unit is a thermoswitch which is rugged, dust-proof, moisture-proof, compact, and fully enclosed. The alarm panel actuated by the thermoswitch may be installed at any convenient point in the car or locomotive. Normally a green light will show, indicating that all detectors are closed and that the wiring is complete. When a dangerous temperature rise occurs, a red light goes on and a buzzer sounds. Grounds are detected by a yellow light which is energized when grounds occur. Test buttons are included for checking the alarm and the ground detector.

The Fenwal thermoswitch is rugged, compact and fully enclosed—It actuates the alarm panel which may be installed at any convenient point in the car

Two systems are manufactured by Fenwal, Inc., Ashland, Mass. For trains of fixed consist the all-electric type is used. This type has a single pair of wires running through the cars carrying the alarm circuit in series through the alarm panels in the various cars to the locomotive. The locomotive unit monitors the entire train and the car units monitor all the individual journals.

For cars not on permanent assignment, the electro-pneumatic system is used. The air signal line transmits the alarm to the cab. An electro-pneumatic timer sends an alarm through the air-signal line in any code desired.

Equipment for these systems is furnished for 32, 64, or 110 volts. Ground-shielded conductors are used for all wiring. The connectors to the truck receptacles are waterproof and flexible, and offer no impediment to the rapid change of axles or trucks.

It's the "KNOW HOW" *here...*

...that BRINGS RESULTS here

The engineering knowledge and experience that go into the preparation of the original design determine the efficiency of the locomotive when it is put in service.

To this basic knowledge Lima adds careful adherence to exact dimensions and specifications during construction. It is through such attention to detail that Lima has earned for itself its enviable reputation as a builder of long-life, economical power . . . power that is capable of hauling heavy loads at the sustained speeds that modern operational requirements demand.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED **INCORPORATED, LIMA, OHIO**

NEWS

J. J. Pelley Dies

JOHN J. PELLEY, president of the Association of American Railroads since its inception in 1934, died in Washington, D. C., on November 12. Mr. Pelley was 68 years old. He had entered the hospital a couple of weeks previously for a check-up and underwent a minor operation a few days prior to his death. He entered railroad service in 1899 and was chief executive of two railroads—first, the Central of Georgia and, then, the New Haven—before he went to Washington to head the A. A. R.

SKF Railway Service Silver Anniversary

ON October 22 and 23 the SKF Industries, Inc., Philadelphia, Pa., commemorated the twenty-fifth anniversary of the introduction of its spherical roller-bearing journal equipment to American railroads. In November, 1921, it equipped six passenger cars of the Pennsylvania Railroad with these bearings and the cars are now being retired from service after a quarter of a century of operation. Fifty-two bearings were used in the first installation and of these 17 are still in operation, having traveled more than 2,600,000 miles. Following this first installation, the Pennsylvania in 1926 ordered roller bearings for 166 more cars. Since that time these bearings have had a wide variety of applications on cars and locomotives.

The anniversary commemoration also marked the introduction of an improved journal-box design. Visitors made a trip through the plants in Philadelphia and were particularly impressed by a new production line operation for the manufacture of journal boxes, the objectives being to use a minimum of manual handling and also to build a better box in less time and at lower cost.

William L. Batt, president of SKF, and the oldest employee in point of service, flew back from Europe to act as host to a large number of railroad officers and railway supply manufacturers, most of whom remained over for the second day to make an inspection of the "ship preservation program" and witness other demonstrations in the Philadelphia Navy Yard.

A. R. C. I. to Study Equipment and Loading Problems

THE American Railway Car Institute has announced the formation of a research "team" of four engineers and transportation specialists to study railway equipment and car-loading problems related to the efficiency of the nation's freight transportation services.

S. M. Felton, president of the Institute, said the following four specialists have been retained by Palmer C. Putnam, the Institute's consulting engineer, to serve as advisory aides. Frederick C. Lindvall, dean of engineering at the California Institute of Technology; Cylde C. Seney, senior staff engineer, of Booz, Allen and Hamilton, New York industrial engineers; Lawrence G. Hecker, design engineer, and George P. Baker, James J. Hill Professor of Transportation at Harvard University and transportation consultant for railroads, as well as a member of the Transportation and Communications Commission of the United Nations.

C. N. J. Receives Diesel for Suburban Service

A 2,000-HP. double-end Diesel-electric passenger locomotive, especially designed for suburban service, was accepted from the Baldwin Locomotive Works by William Wyer, chief executive officer of the Central of New Jersey at a ceremony at Eddystone, Pa., on November 6. The use of this new type of locomotive, Mr. Wyer said, marks the first time any railroad has used such a large type Diesel-electric engine in suburban passenger service. The locomotive, the road's first Diesel-electric passenger locomotive, also marks, according to Mr. Wyer, another first for the Jersey Central in the employment of Diesel-electric motive power. It was in 1925 that the Jersey Central became the first railroad to use Diesel-electric motive power by placing in service a switching locomotive of that type at its Bronx, N. Y., terminal. The switching locomotive is still in use at that terminal and since 1925 the road has added 30 more Diesel-electric switchers to its roster.

Because of continued labor troubles in the coal fields, Mr. Wyer further stated that "the aim of the Jersey Central Lines management is to give the railroad complete independence from the use of bituminous coal and we will continue to replace bituminous-burning locomotives with oil-burning Diesel-electric locomotives as rapidly as possible."

The new locomotive has been named "Frank L. Perkins" after an employee who was killed in the invasion of Normandy. Two other Diesel-electric passenger locomotives, delivery of which is expected from Baldwin before the end of the year, will also be named for Jersey Central employees killed in the recent war.

Yard Radio on the U. P.

THE Union Pacific has installed very high frequency radio for two-way communication between two yard offices and several Diesel switching locomotives in its Kansas City, Kan., yards. This installation has resulted in much time being saved in the dispatching of switching locomotives over many miles of yard tracks in this industrial area, and has eliminated the necessity of crews having to call in by telephone for switching instructions.

The radio equipment is designed for operation on a frequency-modulated channel of 161.85 megacycles, and includes an unattended fixed station, designated KRUP (Kansas Radio Union Pacific), which is comprised of a transmitter and receiver in a case at the base of a 100-ft. floodlight tower at Fairfax yard. The antenna for this station is mounted on top of the tower. The range of this fixed-station equipment is from 12 to 15 miles. Radio operation in both directions from the fixed station is from two remote control points. A seven-mile telephone circuit connects the equipment in the yardmaster's office with the fixed station.

Final plans call for the installation of 50-watt, two-way radio units on 16 Diesel locomotives.

The installation was placed in service at a cost of $25,000, under the jurisdiction of G. R. Van Eaton, superintendent of telegraph. The major items of radio equipment were furnished by the Galvin Manufacturing Corporation, Chicago.

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Atchison, Topeka & Santa Fe	4	6,000-hp. Diesel-electric road	American Loco. Co.
	6	6,000-hp. Diesel-electric road	Electro-Motive
Minneapolis & St. Louis	1[1]	1,000-hp. Diesel electric road	American Loco. Co.
Southern Pacific	20	6,000-hp. Diesel electric frt.	Electro-Motive

FREIGHT-CAR ORDERS

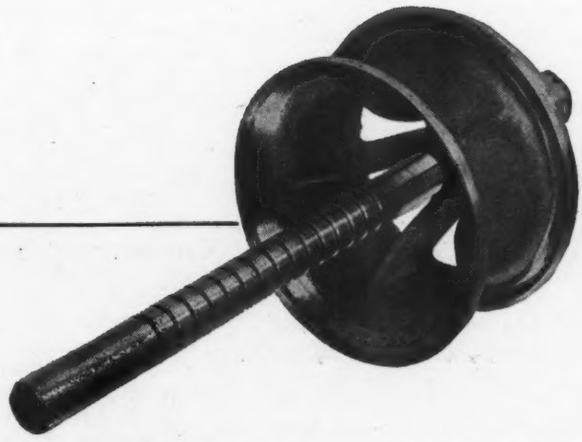
Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	250	50-ton box	Pullman-Standard
Chesapeake & Ohio	10	Box	Co. shops
Chicago, Milwaukee, St. Paul & Pacific	1,600	50-ton box	Co. shops
	2,000	50-ton gondola	Co. shops
	500	50-ton hopper	Co. shops
	150	70-ton covered hopper	Co. shops
	25	Caboose	Co. shops
Louisville & Nashville	300	50-ton flat	Greenville Steel Car
Minneapolis & St. Louis	600	50-ton box	General American
Norfolk & Western	250	50-ton box	Pullman-Standard
Reading	1,000[2]	50-ton box	Co. shops
	25[3]	Caboose	Co. shops
Seaboard Air Line	150	70-ton covered hopper	Bethlehem Steel
Union Pacific	1,000	70-ton ballast	American Car & Fdry.

[1] For delivery in June, 1947. A similar locomotive has been delivered to the road by American Locomotive and early delivery by the Electro-Motive Division of General Motors Corporation of a three-unit 4,050-hp. Diesel-electric freight locomotive is expected.
[2] Cost, $4,250,000.
[3] Cost, $140,000.

POPPET VALVES

will increase power of

underboilered locomotives



The fact that a certain class of locomotive is deficient in boiler capacity is an added and compelling reason for seriously considering installation of the Franklin System of Steam Distribution.

The Franklin System materially increases the horsepower which can be produced from a given quantity of steam. Using poppet valves in place of piston valves, it increases the efficiency of transforming steam into horsepower — will produce, *for the same boiler output and for the same fuel consumption,* 19% to 30% greater maximum power, depending on locomotive design.

This increased capacity may well be the extra power needed to permit an underboilered locomotive to take its place in regular service — either freight or passenger. If so, conversion to poppet valves will be one of the most worthwhile investments you can make.

May we show you what can be done with locomotives which you consider deficient in boiler capacity?

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO • MONTREAL

STEAM DISTRIBUTION SYSTEM • BOOSTER • RADIAL BUFFER • COMPENSATOR AND SNUBBER • POWER REVERSE GEARS
AUTOMATIC FIRE DOORS • DRIVING BOX LUBRICATORS • STEAM GRATE SHAKERS • FLEXIBLE JOINTS • CAR CONNECTION

Supply Trade Notes

NATIONAL PNEUMATIC COMPANY.—*Paul H. Maurer,* formerly research engineer, has been appointed chief engineer in charge of all production engineering, research and development, for the National Company. *John R. Newkirk,* former chief engineer in charge of production engineering, research, and development, has been elected vice-president in charge of all plant operations of the National Pneumatic Company, Rahway, N. J.

John R. Newkirk, after spending five years acquiring practical shop experience,

John R. Newkirk

entered the engineering department of the Baltimore & Ohio at its Newark, Ohio, terminal. He subsequently joined the Jewett Car Company at Newark, where he served as car designer, chief draftsman and superintendent of shops, respectively. In 1919 he became associated with the sales department of National Pneumatic.

◆

UNITED STATES STEEL CORPORATION.—*Dr. J. B. Austin,* assistant director of the Research Laboratory of the United States Steel Corporation of Delaware, at Kearney, N. J., has been appointed director of the laboratory succeeding *Dr. John Johnston,* retired.

◆

TIMKEN ROLLER BEARING COMPANY.—*Russell P. Proffitt,* Chicago divisional manager of the Timken Roller Bearing Company, has been appointed district manager, with headquarters in Washington, D. C. *H. B. Lilley,* development engineer on alloy mechanical tubing, has been appointed district manager of the steel and tube division, with headquarters in Houston, Tex.

◆

LIQUID CONDITIONING CORPORATION.—The Liquid Conditioning Corporation of New York has announced the following appointments in its engineering, sales and service field forces: *Ira J. Bready,* district manager in the Cincinnati, Ohio, territory; *B. F. Soffe,* district manager in the lower Michigan district, with headquarters in Detroit, Mich., and *H. H. Morrison,* district manager in the central and lower south, with headquarters in Chattanooga, Tenn.

◆

GENERAL ELECTRIC COMPANY.—The General Electric Company has purchased from the Reconstruction Finance Corporation the Ft. Wayne, Ind., plant, which it operated during the war.

T. F. Perkinson has been appointed assistant manager of the transportation engineering division of the General Electric Company at Erie, Pa. Mr. Perkinson, a graduate of Rensselaer Polytechnic Institute in 1924 as an electrical engineer, joined General Electric's transportation divisions in 1925, working principally on the development of the Diesel-electric locomotive.

◆

TUCO PRODUCTS CORPORATION.—The Tuco Products Corporation has announced that *A. H. Adkins* will sell and service Tuco specialties in the southeastern territory. Mr. Adkins' headquarters will be at 7347 Wisconsin avenue, Bethesda 14, Md.

◆

AMERICAN BRAKE SHOE COMPANY.—The American Manganese Steel division of the American Brake Shoe Company, Chicago Heights, Ill., has announced the following appointments: *A. R. Sittig,* manager of manganese steel sales and *E. L. Quinn,* assistant vice-president in charge of welding products, both with headquarters in Chicago Heights, and *E. J. Nist,* assistant vice-president, with headquarters in New York.

◆

AMERICAN BRAKE SHOE COMPANY.—Construction has been started on a new American Brake Shoe Company plant in Niles, Ohio, for the manufacture of railroad journal bearings. The new plant, scheduled for completion in six months, will consist of a foundry and machine-shop building, and will be operated by the National Bearing division.

◆

NATIONAL TUBE COMPANY. *Henry J. Wallace* has been appointed general manager of sales of the National Tube Company, a subsidiary of the United States Steel Corporation, succeeding W. F. McConnor, whose election as vice-president of sales was reported in the September issue.

◆

NATHAN MANUFACTURING COMPANY.—*Paul Sarles* has been appointed mechanical engineer of the Nathan Manufacturing Company, New York. Mr. Sarles was formerly associated with the Lima Locomotive Works and the Chicago, Burlington & Quincy.

◆

GRAYBAR ELECTRIC COMPANY.—*Edward R. Yonkers,* former assistant district manager, has been appointed Wolverine district manager of the Graybar Electric Company, with headquarters in Detroit, Mich. *A. R. Maynard* retired.

John E. Fontaine has been appointed manager at Houston, Tex., and *Lynn A. Haley* succeeds Mr. Fontaine as manager at Beaumont, Texas.

MONTREAL LOCOMOTIVE WORKS, LTD.—*Hagbart Johnsen* has been appointed mechanical engineer of the Montreal Locomotive Works, Ltd. Mr. Johnsen is a graduate of the Norwegian Technical university (1926), with a degree in mechanical engineering. He joined Montreal Locomotive in 1928, and until his appointment as mechanical engineer, served as designing engineer and plant engineer.

◆

INTERNATIONAL NICKEL COMPANY.—*J. E. Fifield,* formerly with the United States Naval Research Laboratory and the American Brake Shoe Company, has joined the development and research division of the International Nickel Company, with headquarters at 75 Pearl street, Hartford, Conn.

◆

OKONITE COMPANY. *John L. March,* recently returned from service in the United States Navy, has been placed in charge of insulated wire and cable sales for the Okonite Company in the new sales office at 417 Merchants Bank building, Indianapolis 4, Ind.

◆

AMERICAN STEEL FOUNDRIES.—*Walter H. Baselt* and *David M. Light* have been appointed mechanical assistants to G. H. Snyder, vice-president in charge of railway sales for the American Steel Foundries. Mr. Baselt was formerly mechanical assistant to the vice-president in charge of product engineering and Mr. Light served the company as sales engineer.

◆

BALDWIN LOCOMOTIVE WORKS.—*W. Metzger,* vice-president in charge of operations at the Eddystone, Pa., division of Baldwin, has been appointed a director to succeed *Charles L. Stillman,* resigned. *Elmer A. Mulson,* sales engineer with the Barney Machinery Company, Pittsburgh, Pa., for the past ten years, has been appointed manager of the Pittsburgh district

Elmer A. Mulson

office of Baldwin. Mr. Mulson will represent the company in its sales of steam and Diesel-electric locomotives, testing machines, industrial presses, marine propellers and alloy castings.

The Two Tennesseans

More than five years of operation in heavy-duty fast passenger service — with availability records of 100% and 99.6% — that's the record set up by two General Motors Diesel locomotives hauling the two Tennesseans on the Southern Railway System since May 1941.

Since this is plenty of time to test any locomotive, let's look at the individual records of these two Diesels, hauling 13-car trains in and about the rugged Tennessee mountains.

NUMBER 2900 has a perfect record. It has met its total assigned mileage for 63 months — 100% of the time — didn't miss a single trip. This locomotive ran up a grand total of 1,077,588 miles, an average of 17,105 miles per month. Finally it was called in for a look-over and possible repair, although it did not break down.

NUMBER 2901 has a near perfect record. It has been available 99.6% for its assigned mileage during the 63 months. This locomotive has accumulated 1,073,608 miles — no mileage missed on account of mechanical trouble, and is still in service at this writing. Monthly average, 17,041 miles.

These brilliant records are just about tops — yet indicative of the splendid service rendered by all General Motors Diesels. For these Diesels are designed and built by Diesel locomotive specialists — produced in America's best equipped completely-Diesel locomotive plant.

YOUTHFUL IN STAYING POWER

GM LOCOMOTIVES

VETERANS IN PERFORMANCE

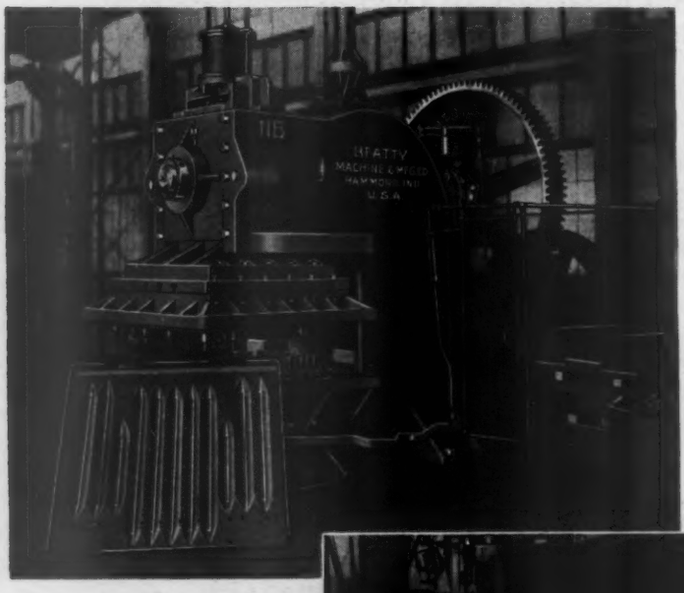
ELECTRO-MOTIVE DIVISION

GENERAL MOTORS LA GRANGE, ILL.

Exceptionally large die space adapts machine to a wide variety of set-ups

LEADING RAILROAD SHOPS AND CAR BUILDERS USE

BEATTY machines



BEATTY NO. 11-B
MULTIPLE PUNCH AND
SPACING TABLE

A BEATTY heavy duty punch, equipped with special tools, can handle the most complicated punching and slotting requirements in one pass through. It is an important unit in the complete line of BEATTY-ENGINEERED punches, presses, shears, bull-dozers and spacing tables extensively used in your industry. When you have a heavy metal working problem to solve let us give you the benefit of our long and intimate experience in your field.

BEATTY MACHINE AND MFG. COMPANY
HAMMOND, INDIANA

690 (Adv. 66)

INDEPENDENT PNEUMATIC TOOL COMPANY.—*W. C. Rush,* sales and service engineer at St. Louis, Mo., for the Independent Pneumatic Tool Company, Chicago, has been appointed manager of the company's branch at Pittsburgh, Pa. *H. C. Brown* becomes manager of the new branch office at 426-428 Elm street, Cincinnati, Ohio.

◆

SNAP-ON TOOLS CORPORATION.—*Milton B. Steinmetz,* manager of railroad sales for the Snap-On Tools Corporation, has been appointed also industrial sales manager, a newly created position.

◆

HEYWOOD-WAKEFIELD COMPANY.—*Ken J. Conway* has been appointed sales representative in the Chicago office of Heywood-Wakefield Company.

◆

GENERAL MOTORS CORPORATION.—*H. B. Ellis,* director of parts and service of the Electro-Motive division of General Motors Corporation, has been appointed assistant to vice-president of G. M. C. The position of director of parts and service of the Electro-Motive division has been abolished. Mr. Ellis entered the service of the Electro-Motive division in 1926, after 16 years' service with the White Motor and Cleveland Tractor companies. In 1928 he was appointed assistant service manager, in 1930, service manager, and in 1944 director of parts and service. Mr. Ellis' name is associated with the raised platform and depressed floor principle in layout of Diesel maintenance and repair shops. He has also been closely associated with the development of the La Grange Diesel locomotive school.

H. B. Ellis

◆

WESTINGHOUSE ELECTRIC CORPORATION.—*L. A. Hester* has been appointed manager of the Middle Atlantic district transportation division of the Westinghouse Electric Corporation, with headquarters in Philadelphia, Pa., to succeed *R. F. Moon,* who has been named special representative.

L. A. Hester is a graduate of Virginia Polytechnic Institute at Blacksburg, Va., (1923), with a bachelor of science degree in electrical engineering. In the same year he joined Westinghouse at East Pittsburgh, Pa. He has since served in various capacities with the transportation branch.

L. A. Moon is a graduate of Rutgers

Progress in Transportation

means PROGRESS IN BRAKING

When you review the progress in railway transportation over the years, one important fact stands out: Brakes are basic to railroad progress. That's why every advance in power, speed and capacity is accompanied and accelerated by a commensurate advance in the brake system.

Expanding passenger travel creates expanded emphasis on adequate braking. With the current trend toward higher speeds in passenger service, trains need a brake to match their increased "go" power. It's ready and waiting, in the Westinghouse "HSC" electro-pneumatic brake.

For the utmost in performance for passenger safety and comfort, we recommend this proven combination:

"HSC" Electro-Pneumatic Brake **. . . for brake flexibility to match modern train speeds, and unequaled smooth action.** ***Speed Governor Control*** **. . . for regulating brake forces to wheel speeds.** ***"AP" Decelostat*** **. . . for wheel slip detection to keep the wheels rolling.**

Brakes are Basic to Railroad Progress

Westinghouse Air Brake Co.

WILMERDING, PA.

BRICKSEAL

REFRACTORY COATING

FLINT HARD WHEN COLD

Brickseal becomes flint hard as it cools — protects walls from damage.

APPLIED LIKE PAINT—Brickseal, a combination of high fusion clays and metal oxides, protects refractories . . . preserves brickwork . . . prevents cracking, spalling and flame abrasion.

When heated, Brickseal deeply penetrates the pores and joints of the bricks and forms a highly glazed ceramic coating for refractory walls.

Brickseal is also used as a bonding material; it produces a tight brick-to-brick joint and welds the wall into one solid unit. Write for illustrated booklet; ask for a demonstration.

Brickseal is semi-plastic when hot allowing it to expand and contract with the furnace

SEMI-PLASTIC WHEN HOT

BRICKSEAL

REFRACTORY COATING

5800 S. Hoover St., Los Angeles, Calif.

1029 Clinton St., Hoboken, N. J.

University at New Brunswick, N. J., (1904), with a bachelor of science degree in electrical engineering. He began his career as an apprentice at the East Pittsburgh works, after which he entered the transportation sales division at Philadelphia.

Obituary

ROSWELL D. GRANT, vice-president of The Pyle-National Company, Chicago, died suddenly at his home in that city on October 29. He had been associated with Pyle-National for 33 years.

◆

HOMER V. MCKEDY, New York railway sales representative of the Patterson-Sargent Company for 22 years, died on October 30.

◆

EDWIN STRASSBURGER, St. Louis, Mo., representative for the Buffalo Brake Beam Company since 1906, died at his home on November 4. He was 77 years old.

◆

J. TRUMAN EVANS, manager of the locomotive sales department of the Vulcan Iron Works, Wilkes-Barre, Pa., died on October 19. Mr. Evans was associated with the company for more than 50 years.

◆

JOSEPH D. HORTON, purchasing agent of the Union Spring & Manufacturing Co., New Kensington, Pa., died on October 22. Mr. Horton had been associated with the company for 35 years.

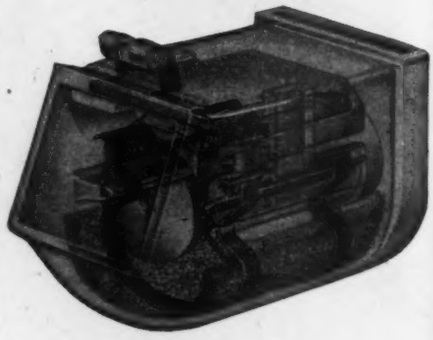
◆

L. LEWIS COHEN, chairman of the board of directors of the Union Asbestos & Rubber Co., died of a heart attack on October 25 at his home in Highland Park, Ill. Mr. Cohen was born on May 7, 1891, at Chicago. In his youth he worked both for the Union Pacific and Southern Pacific, and later became secretary of Julius Kruttschnitt, at one time chairman of the Southern

L. Lewis Cohen

Pacific's executive committee. Mr. Cohen was associated for a time with the sales department of Johns-Manville Sales Corporation. In 1916, he founded the Union Supply Company, and in 1918 organized the Union Asbestos & Rubber Co. He was president of the latter company until 1941, when he retired because of ill health and became chairman of its board of directors.

ROBOT PACKING RETAINERS PREVENT HOT BOXES



ROBOT Packing Retainers work ceaselessly to stop waste grabs by keeping packing in proper position and preventing any lint or strands of waste from the bearing. This is what it means to your road:

1

Saves *time and eliminates delay of trains setting out cars having hot boxes.*

2

Prevents *costly replacement of wheel and axle units due to cut journals.*

3

Increases *the service life of the journal bearings by insuring proper lubrication.*

4

Reduces *yard and terminal inspection time by keeping packing in proper position.*

5

Keeps *needed cars off the repair tracks and available for service.*

ROBOT Retainers are easy to apply and once installed will not require maintenance. They fit any style journal box including types with waste retaining ribs.

ROBOT Retainers are manufactured for locomotive tenders, passenger and freight cars in all journal sizes.

CHICAGO FREIGHT CAR & PARTS CO.

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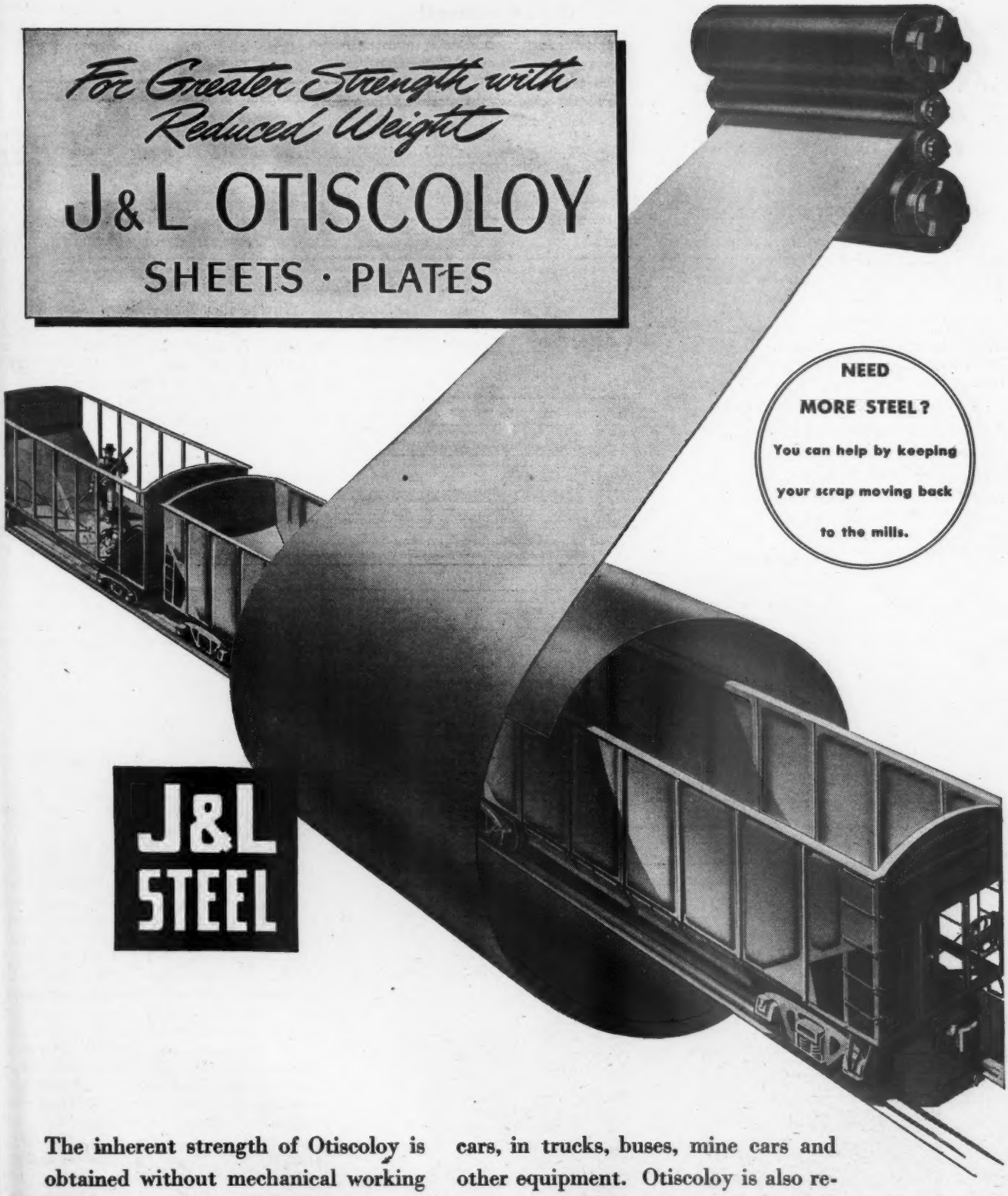
For Greater Strength with Reduced Weight

J&L OTISCOLOY

SHEETS · PLATES



NEED MORE STEEL?

You can help by keeping your scrap moving back to the mills.

J&L STEEL

The inherent strength of Otiscoloy is obtained without mechanical working or heat treating, which gives it exceptional weldability and formability for a high-tensile steel. It is being used successfully to reduce dead-weight and increase pay load in railroad freight cars, in trucks, buses, mine cars and other equipment. Otiscoloy is also resistant to abrasion and corrosion. Our metallurgical engineers will be glad to discuss the application of Otiscoloy to your production problems. Write for further information.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PA.

Personal Mention

Diesel

O. A. LARSON has been appointed Diesel locomotive inspector of the New York Central system, with headquarters at New York.

Master Mechanics and Road Foremen

H. C. MCFARLAND has been appointed master mechanic of the Peoria & Eastern (a part of the New York Central System), with headquarters at Urbana, Ill.

W. W. WALKER has been appointed master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Dodge City, Kan.

W. S. TASKER, master mechanic of the Atchison, Topeka & Santa Fe at Wellington, Kan., has retired.

OLIVER G. SUMNER has been appointed road foreman of engines, Mechanical Department, all divisions, of the Norfolk & Southern, with headquarters at Raleigh, N. C.

L. B. JOHNSON, master mechanic of the Atchison, Topeka & Santa Fe at Clovis, N. M., has been transferred to the position of master mechanic at Wellington, Kan.

A. M. ARMER, master mechanic of the Peoria & Eastern (a part of the New York Central System), at Urbana, Ill., has retired after 44 years of service.

Car Department

A. S. WILLISTON, assistant foreman of the running repair shop of the Canadian National at Moncton, N. B., has been promoted to the position of car foreman at Sydney, N. S.

Obituary

FRANK T. SUMNER, road foreman of engines, Mechanical Department, all divisions, of the Norfolk Southern at Raleigh, N. C., died on October 16.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

DRILLING AND TAPPING SMALL PARTS.—Ettco Tool Co., 594 Johnson avenue, Brooklyn 6, N. Y. Bulletin No. 31 describes Ettco-Emrick system for fast-multiple drilling and tapping of small parts.

◆

B. & W BOILER TUBES.—Joseph T. Ryerson and Son, Inc., Box 8000-A, Chicago 80. An eight-page illustrated bulletin describes and illustrates the stocks of Babcock & Wilcox electric-resistance-welded boiler tubes handled by the Ryerson plants.

HYDRAULIC PIPE BENDER.—Watson-Stillman Company, Roselle, N. J. Eight-page bulletin, No. A-7, descriptive of the W-S portable hydraulic pipe bender.

◆

ROTARY LEVELATORS.—Rotary Lift Company, 1054 Kansas street, Memphis 2, Tenn. Catalogue RE-201 describes and illustrates the Levelator, an oil-hydraulic elevating device for the handling of freight from plant floors into trucks and freight cars; for the positioning of materials on the production floor, and for eliminating ramps between different building levels.

◆

HURON PRODUCTS.—Huron Manufacturing Company, 3240 Woodbridge street, East, Detroit 7, Mich. Staple-bound pages of illustrated Catalogue No. 9 gives descriptive data on Huron products—boiler and tender plugs, washout and arch-tube plugs and bushings, tools, venetian spark arrester, etc.

◆

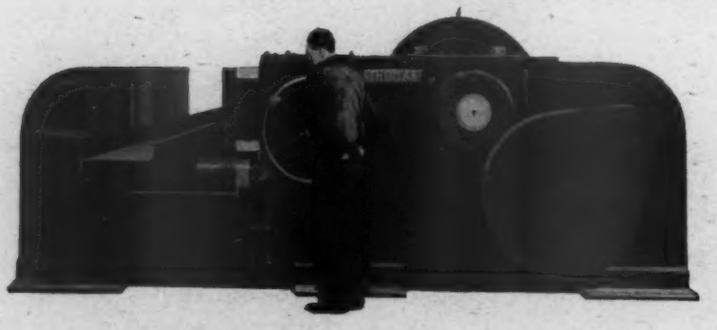
USS COR-TEN.—United States Steel Corporation Subsidiaries, 429 Fourth avenue, Pittsburgh 19, Pa. Wire-bound, 68-page booklet, "USS Cor-Ten for High Strength, Light Weight, at Low Cost" printed in two colors. First section discusses various properties of Cor-Ten, including its high resistance to atmospheric corrosion, and their utilization. Second section gives data regarding fabrication by standard practices, including five pages on welding. Deals also with the applications of Cor-Ten in passenger and freight equipment of all classes, trucks, material handling equipment, etc.

Miscellaneous Publications

ALUMINUM ALLOYS.—Reynolds Metals Company, Inc., Dept. 47, 2500 South Third street, Louisville 1, Ky. *"Heat Treating Aluminum Alloys,"* 144 pages, 6 in. by 9 in., wire bound. Price $1.00. Book prepared for the non-technical man and the highly trained technician. Section 1 explains, simply, the what, why and how of heat treating aluminum. Section 2 presents in brief tabular form the recommended thermal treatments for the various aluminum alloys. Section 3, for the metallurgist and operating personnel, gives a more technical discussion of the various thermal treatments as well as detailed information on possible difficulties and suggestions for overcoming them. Photomicrographs show normal and abnormal metallographic structures. *"Machining Aluminum Alloys."* 124 pages, 6 in. by 9 in., wire bound. Price $1.00. Charts, in spreads of two pages, give detailed data on recommended tooling, speeds, and feeds for particular types of machining operations. Individual charts cover turning, milling, shaping and planing, drilling, reaming, tapping, filing, and sawing. Lists also five important points to remember when machining aluminum. First five chapters contain a general discussion of machining characteristics of the various aluminum alloys; machining conditions; tool materials and designs; cuts, speeds and feeds, lubricants, coolants and cutting compounds. Nine other chapters devoted to individual discussion of the different machining operations, with details on tooling, cuts, speeds, feeds, coolants, etc.

THOMAS

BENDING AND STRAIGHTENING Machines



THESE MODERN MACHINES are of all-steel construction and come in various sizes, in capacities from 50 to and including 400 tons. Convenient adjustments for easy, accurate operation.

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For HIGH Temperatures and EXTREME Pressures

Thicknesses from 1/64" to 1/4". Sheets 40" x 40" and larger.

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WHEN temperatures are extra high and pressures are excessive, that's the time to use GARLOCK 7021 Compressed Asbestos Sheet Packing. Gaskets cut from 7021 give superior service on pipe lines and other equipment handling gasoline, oil, gas or steam at high temperatures and extreme pressures. Tough, yet resilient, GARLOCK 7021 is economical and efficient under severe conditions.

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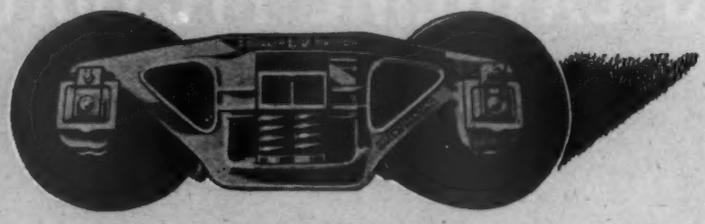
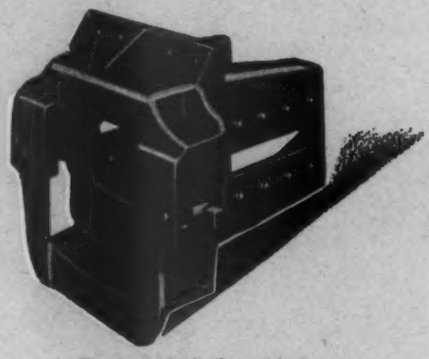
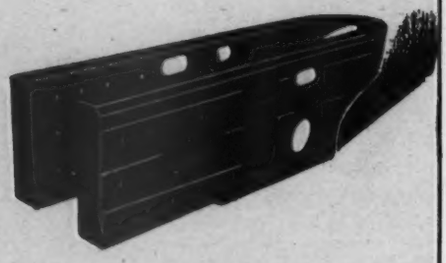


Scullin Cushioned LATERAL-VERTICAL Motion Truck

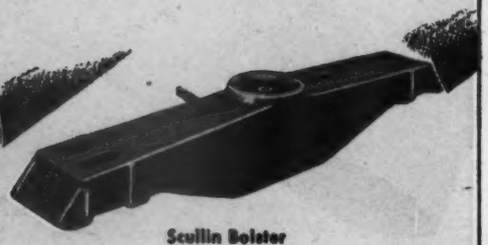


Scullin A. A. R. Striker with integral front draft lugs

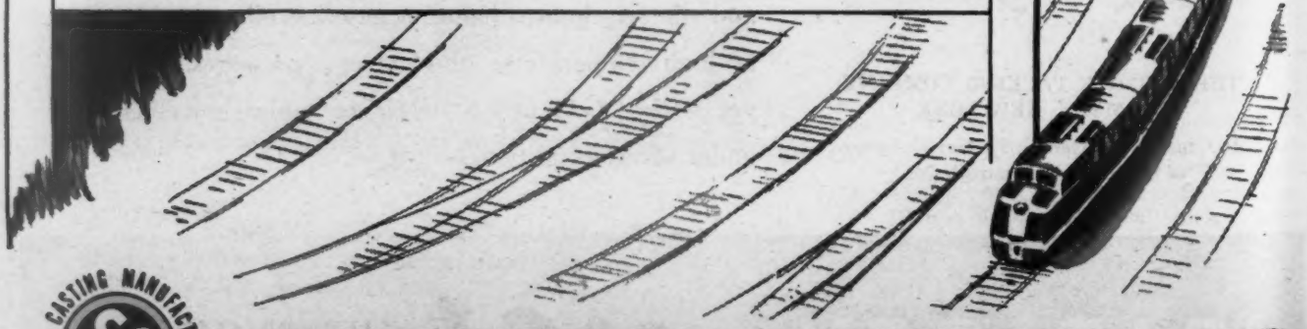


Scullin A. A. R. Bolster Center Filler with integral rear draft lugs

Scullin Side Frame



Scullin Bolster



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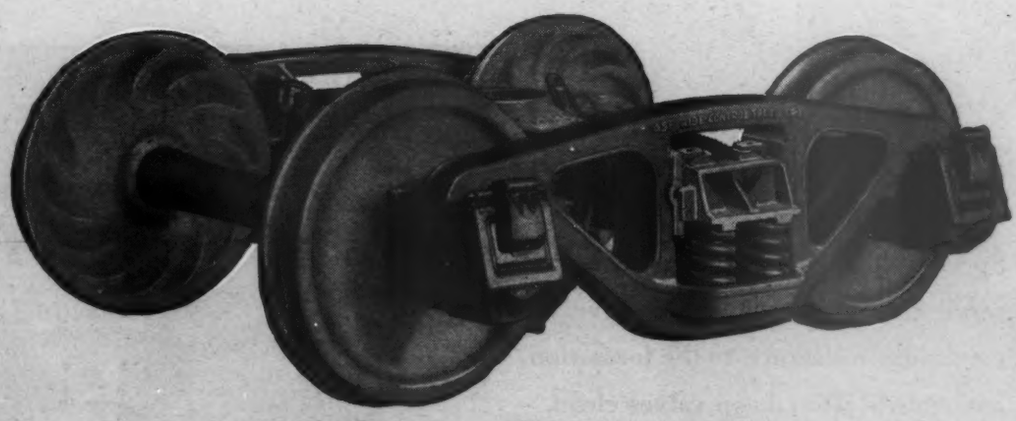
Acceptance

Two-thirds of all the American Railroads using Ride-Control Trucks have already re-ordered—one as often as 13 times.

More than 42,000 sets of this easy-riding truck are in service or on order for 64 railroads and private car owners. Ride-Control is the modern truck for all loads, all speeds, all needs.



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NO SPRING PLATES • NO SPRING PLANKS

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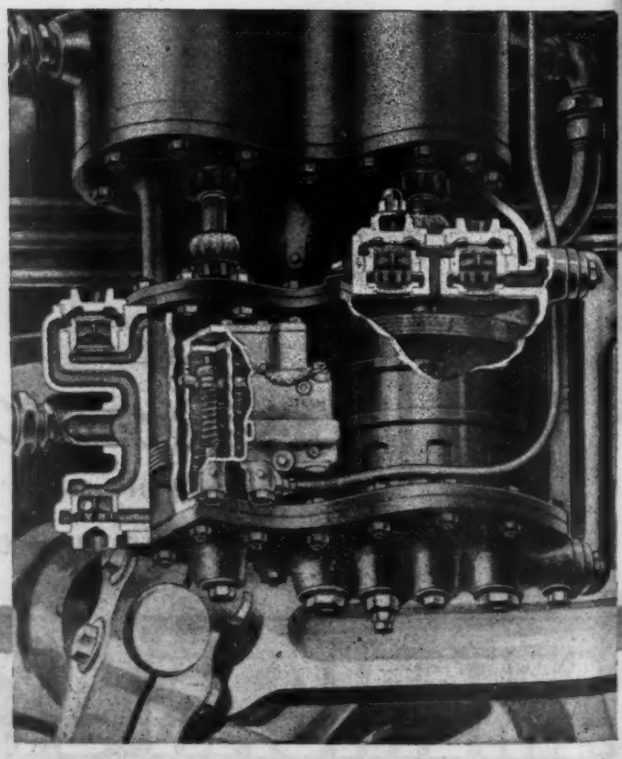
AMERICAN STEEL FOUNDRIES

MINT-MARK OF ◯ FINE CAST STEEL

Setting the Pace

Special Oils for Steam-Driven Air-Pumps!

Specially developed for air-pump service, Socony-Vacuum Oils give maximum resistance to the formation of deposits. They keep valves clean, protect pistons, rings and cylinders against wear.



for Progress!

Socony-Vacuum Lubricants Help Keep Railroad Diesels on the Job—Assure Maximum Performance!

MATCHING the railroad progress represented by these big Diesel-Electric Locomotives, Socony-Vacuum offers lubricants specially developed to assure continuous peak performance and maximum protection against wear.

Proved in the toughest kind of service, Socony-Vacuum Oils now are recognized as outstanding lubricants for the power plants of all types of Diesel locomotives. Their unusual stability enables them to stand up under the most severe operating conditions. They resist the formation of deposits, keep valves and rings operating freely, and maintain their rich lubricating qualities over long periods. They form strong films that resist rupture under high pressures, protecting highly stressed parts against destructive friction and wear.

Other Gargoyle lubricants provide maximum protection for driving motor pinions and gears, and for all other equipment. Rely on Socony-Vacuum for Correct Railroad Lubrication!

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SPEEDY PATROL

• **One button tests the controller on each truck**

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prevent slid flat wheels . . .
with the
AMERICAN BRAKE SHOE CONTROLLER

CONSTANT CONTROL

Like alert policemen in today's quick-starting, fast patrol cars, the American Brake Shoe Controller is always prepared to sweep instantly into action. It is a constant protection against slid flat car wheels. Being completely *electrical,* it operates immediately. It gives railroad men the important operating benefits of car availability at all times.

The American Brake Shoe Controller is a positive-acting device . . . accurate and unfailing . . . simple and rugged. It detects wheel slippage at the first sign, corrects that situation almost instantaneously, and then restores full brake at the moment when slippage has been eliminated. The American Brake Shoe Company, 230 Park Avenue, New York 17, N.Y.

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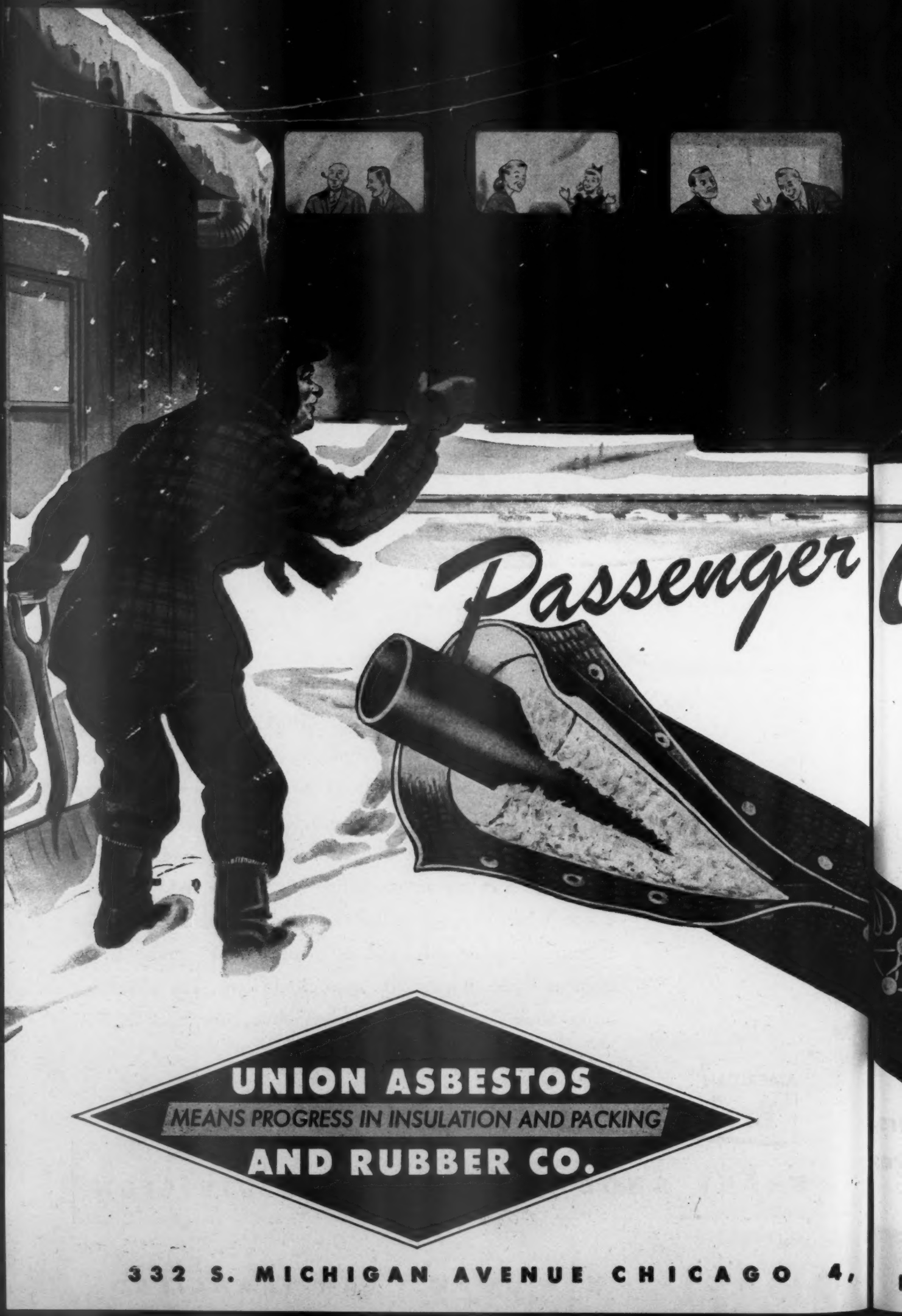

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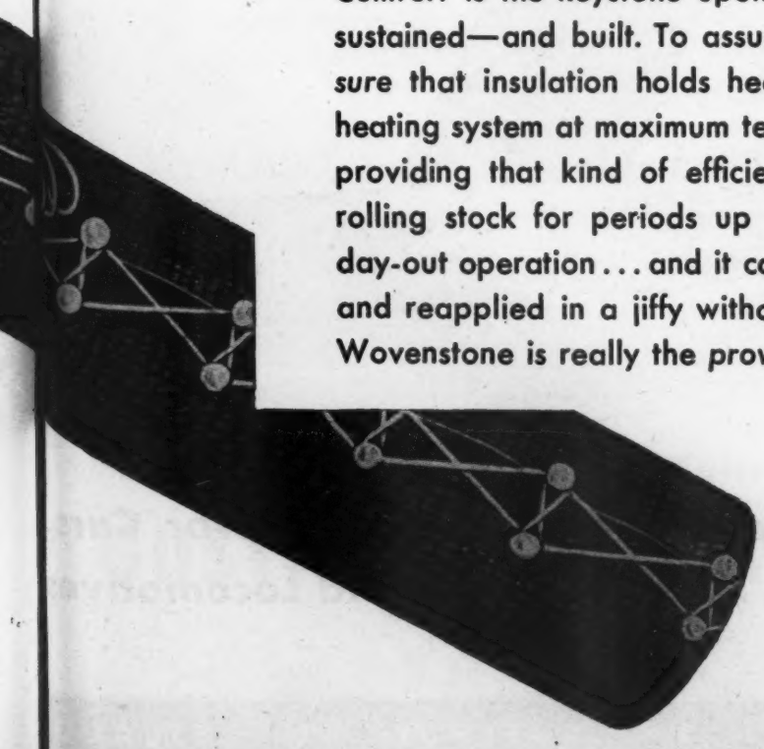
Comfort

begins OUTSIDE the car when steam pipes are COVERED by WOVENSTONE!

Comfort is the keystone upon which revenues are going to be sustained—and built. To assure maximum comfort, you must be *sure* that insulation holds heat in—delivers steam to the car heating system at maximum temperatures. Wovenstone has been providing that kind of efficient, economical service—on much rolling stock for periods up to 12 years of continuous day-in, day-out operation . . . and it can be removed for pipe inspection and reapplied in a jiffy without loss of original efficiency. Yes, Wovenstone is really the *proven* insulation!



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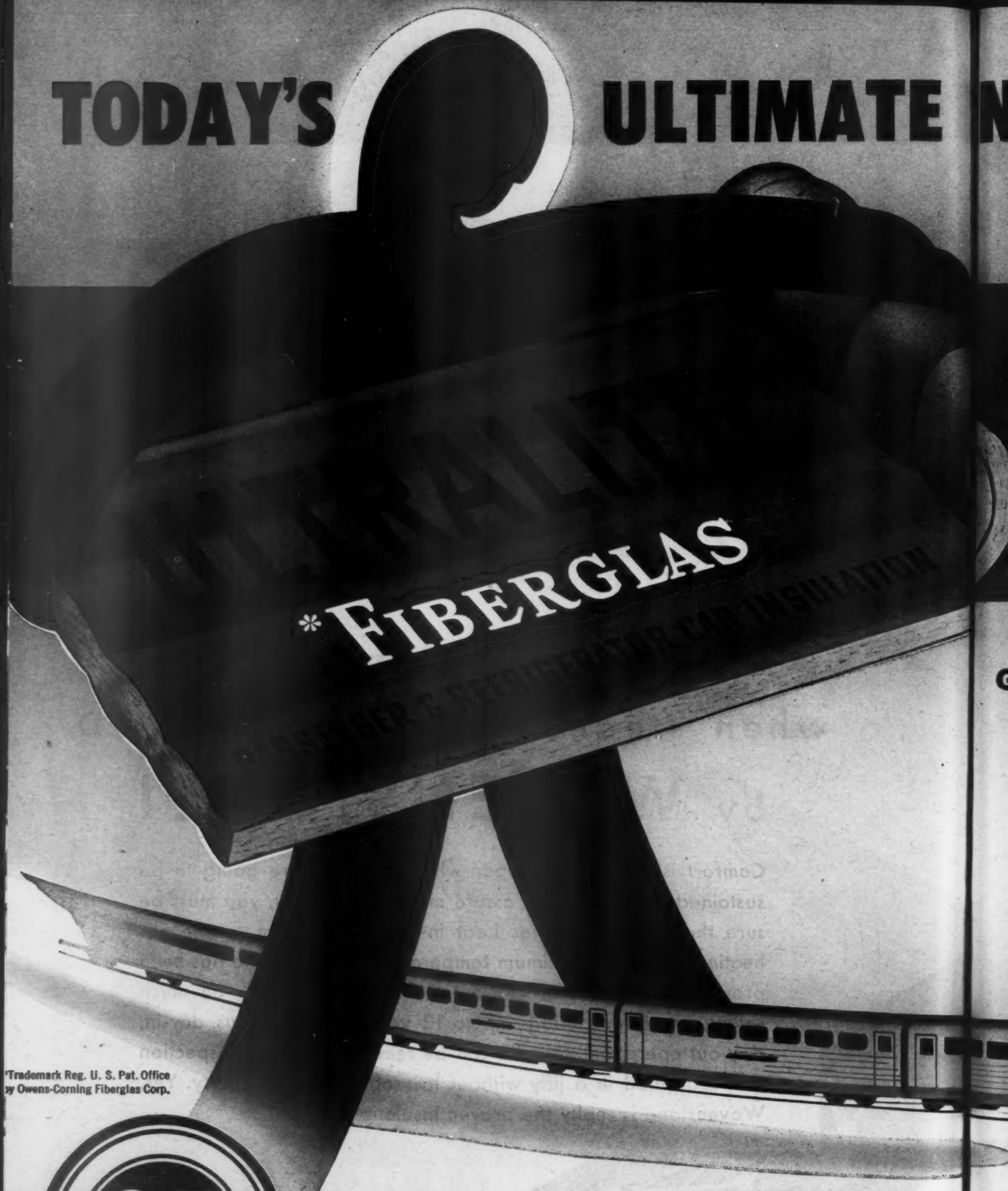

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Thermal Insulation For Refrigerator Cars, Tank Cars, Passenger Cars and Locomotives

NEW YORK • PHILADELPHIA • CHICAGO

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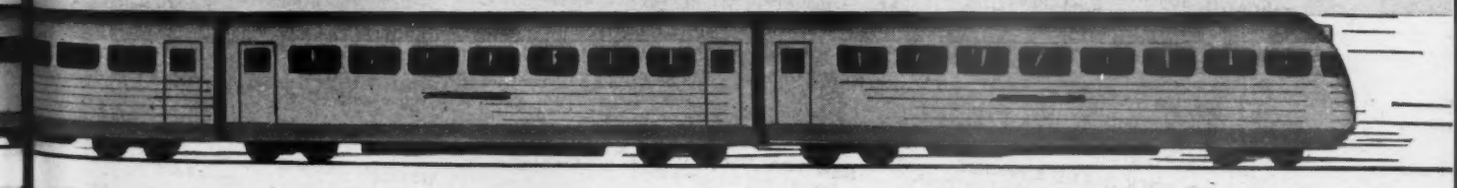
G-B ULTRALITE SAVES UP TO 1/2 THE INSULATION WEIGHT

Combined into G-B Ultralite Insulation, made from Fiberglas fibers, are weight and service factors that make it today's unequalled railway insulation. For the swift new luxury trains, in particular, the light weight of G-B Ultralite has proved of decided advantage in their construction and operation. G-B Ultralite contributes not only to lower operating cost but to a higher degree of passenger comfort and safety—and maintains full thermal and acoustical effectiveness for the life of the car. Developed exclusively as railway insulation, G-B Ultralite is manufactured with or without facing in pliable easy-to-handle forms for both passenger and refrigerator car installation.



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88% of the passenger-train cars ordered to date for postwar delivery *will be*

PASSENGER EQUIPMENT ALREADY ORDERED for post-war delivery to be built with U·S·S Stainless Steel and/or U·S·S COR-TEN

ATCHISON, TOPEKA & SANTA FE
43—U·S·S Stainless Steel—Budd
115—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard
25—U·S·S Cor-Ten—Amer. Car & Fdy.

ATLANTIC COAST LINE
21—U·S·S Stainless Steel—Budd
60—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard

BALTIMORE & OHIO
24—U·S·S Cor-Ten—Pullman-Standard

BOSTON & MAINE
12—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard

CENTRAL OF GEORGIA
4—U·S·S Stainless Steel—Budd
10—U·S·S Cor-Ten—Amer. Car & Fdy.

CHESAPEAKE & OHIO
46—U·S·S Stainless Steel—Budd

CHICAGO & EASTERN ILLINOIS
11—U·S·S Cor-Ten—Pullman-Standard

CHICAGO, GREAT WESTERN
3—U·S·S Cor-Ten—Pullman-Standard

CHICAGO, BURLINGTON & QUINCY
44—U·S·S Stainless Steel—Budd

CHICAGO & NORTH WESTERN
78—U·S·S Cor-Ten—Pullman-Standard
20—U·S·S Cor-Ten—Amer. Car & Fdy.

CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC
28—U·S·S Cor-Ten—Pullman-Standard
186—U·S·S Cor-Ten—Company Shops

CHICAGO, ROCK ISLAND & PACIFIC
57—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard

DELAWARE, LACKAWANNA & WESTERN
4—U·S·S Stainless Steel—Budd
24—U·S·S Cor-Ten—Amer. Car & Fdy.

DENVER & RIO GRANDE WESTERN
13—U·S·S Stainless Steel—Budd

ERIE
7—U·S·S Cor-Ten—Pullman-Standard

FLORIDA EAST COAST
20—U·S·S Stainless Steel—Budd
16—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard
4—U·S·S Cor-Ten—Amer. Car & Fdy.

GREAT NORTHERN
61—U·S·S Cor-Ten—Pullman-Standard
15—U·S·S Cor-Ten—Amer. Car & Fdy.

GENERAL MOTORS
4—U·S·S Cor-Ten—Pullman-Standard

ILLINOIS-CENTRAL
35—U·S·S Cor-Ten—Pullman-Standard

MAINE CENTRAL
12—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard

KANSAS CITY SOUTHERN
10—U·S·S Cor-Ten—Amer. Car & Fdy.

LACKAWANNA
24—U·S·S Cor-Ten—Amer. Car & Fdy.

MINNEAPOLIS & ST. LOUIS
6—U·S·S Stainless Steel—Budd

MISSOURI-KANSAS-TEXAS
14—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard

MISSOURI PACIFIC
10—U·S·S Stainless Steel—Budd

NEW YORK CENTRAL
239—U·S·S Stainless Steel—Budd
353—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard
128—U·S·S Cor-Ten—Amer. Car & Fdy.

NEW YORK, NEW HAVEN & HARTFORD
180—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard.

NORTHERN PACIFIC
78—U·S·S Cor-Ten—Pullman-Standard

NORFOLK & WESTERN
21—U·S·S Cor-Ten—Pullman-Standard

PENNSYLVANIA
98—U·S·S Stainless Steel—Budd
99—U·S·S Cor-Ten—Pullman-Standard
66—U·S·S Cor-Ten—Amer. Car & Fdy.
90—U·S·S Cor-Ten—Company Shops

PERE MARQUETTE
18—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard

READING
8—U·S·S Cor-Ten—Amer. Car & Fdy.

RICHMOND, FREDERICKSBURG & POTOMAC
14—U·S·S Stainless Steel—Budd
15—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard
7—U·S·S Cor-Ten—Amer. Car & Fdy.

SEABOARD AIRLINE
36—U·S·S Stainless Steel—Budd
13—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard
3—U·S·S Cor-Ten—Amer. Car & Fdy.

ST. LOUIS — SAN FRANCISCO
38—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard

SOUTHERN
41—U·S·S Stainless Steel—Budd
76—U·S·S Stainless and U·S·S Cor-Ten*
—Pullman-Standard
23—U·S·S Stainless and U·S·S Cor-Ten*
—Amer. Car & Fdy.

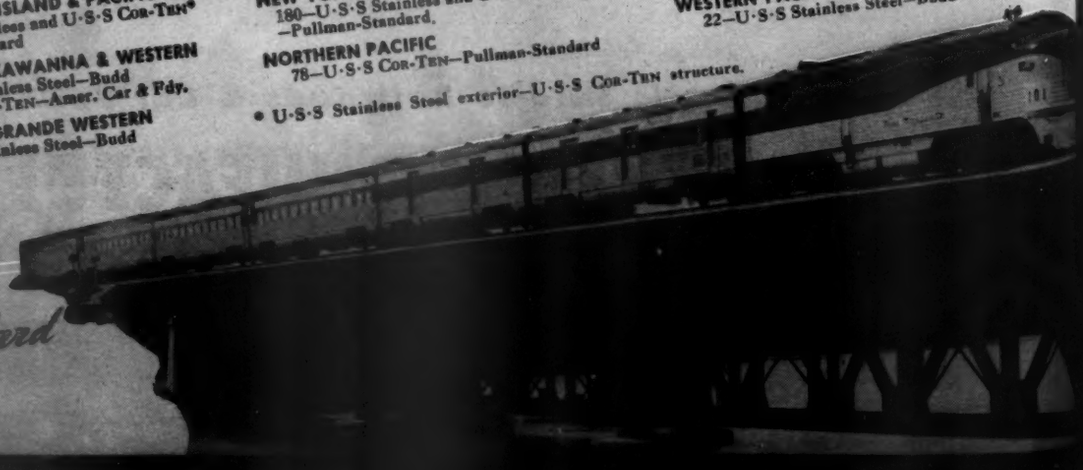
SOUTHERN PACIFIC
23—U·S·S Cor-Ten—Pullman-Standard

UNION PACIFIC
80—U·S·S Cor-Ten—Amer. Car & Fdy.

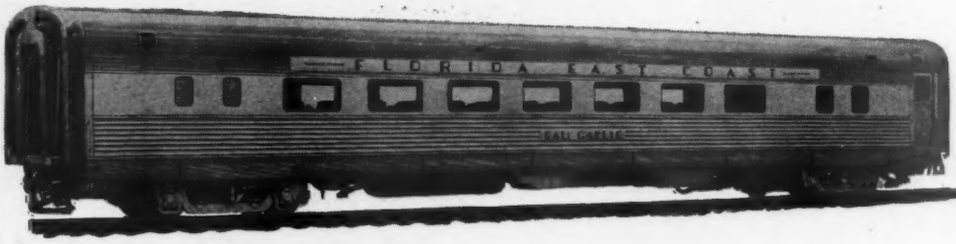
WABASH
15—U·S·S Cor-Ten—Amer. Car & Fdy.

WESTERN PACIFIC
22—U·S·S Stainless Steel—Budd

* U·S·S Stainless Steel exterior—U·S·S Cor-Ten structure.



Pullman-Standard



Budd

built with U·S·S Stainless Steel

or U·S·S COR-TEN ... or both

THE use of these fine structural steels in 2850 new post-war passenger cars—already in service, now building or on order—is based on their outstanding performance in lightweight passenger equipment built before the war.

Up to the present, a grand total of 4770 passenger train units — sleepers, coaches, diners, baggage and mail cars, etc.—have been built or ordered built lighter, stronger and longer lasting with U·S·S Stainless Steel and U·S·S COR-TEN, used alone or together.

Using U·S·S Stainless Steel and U·S·S COR-TEN, leading car builders and railroads have developed equipment that ranks as the most modern, most efficient and most profitable of its kind in the world.

Our experience in producing these steels and in cooperating with owners, designers and builders in their application has given us a background of practical knowledge which we gladly place at your disposal.

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
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NATIONAL TUBE COMPANY, *Pittsburgh*
United States Steel Supply Company, Chicago, *Warehouse Distributors*
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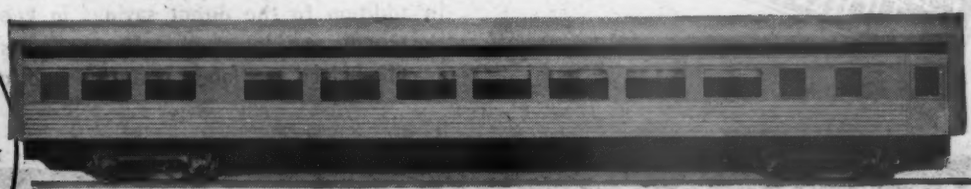
USS STEEL
UNITED STATES STEEL



a.c.f.

UNITED STATES STEEL

DRIP-DRIP-DRIP GO THE PROFITS

TIME OUT for locomotive running gear repairs is costly. It has been estimated for instance that a freight locomotive of 65,000 lb. tractive force costs 6½ cents for every minute it remains out of service over and above the actual cost of repairs. That's almost $100 a day!

Hennessy Mechanical Journal Lubricators prevent many of these dollars from slipping through your fingers. As a result of more effective lubrication of journals and hub faces, the time between running gear repairs is extended from three to five times. This means a notable increase in revenue-producing hours on the road. In addition to the direct savings in keeping the locomotives in continuous use, less terminal attention is necessary, hot bearings are eliminated and labor, materials and lubricant are conserved.

HENNESSY LUBRICATOR

HENNESSY LUBRICATOR CO., INC.

75 WEST STREET NEW YORK 6, N. Y.

The answer to one maintenance problem...

Keeping motive power nuts and bolts tight is a problem maintenance men lick by specifying Reliance Locomotive Hy-Crome Spring Washers.

Their adequate and calibrated reactive pressure automatically compensates for looseness caused by the stresses and strains to which rolling stock is subjected. They maintain correct bolt tension.

They hold bolted assemblies *tighter longer* . . . reduce shopping time and increase equipment availability.

Write for illustrated folder of *"Reliance Locomotive Hy-Crome Spring Washers"* and the list of more than 50 vital points where they help to minimize motive power maintenance.

EATON

EATON MANUFACTURING COMPANY

Reliance LOCOMOTIVE HY-CROME *spring washers*

RELIANCE DIVISION
MASSILLON, OHIO

Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

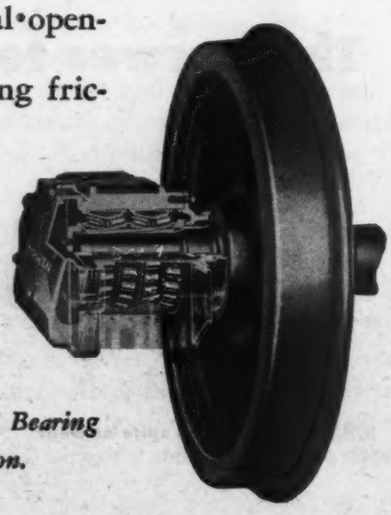
A GREAT FORWARD STEP IN RAILROADING

RAILWAY EXPRESS AGENCY SPECIFIES TIMKEN ROLLER BEARINGS FOR 500 NEW EXPRESS REFRIGERATOR CARS

An extract from Railway Express Agency's announcement of the awarding of these cars to the American Car and Foundry Company reads as follows:

> "TIMKEN ROLLER BEARINGS will reduce the starting friction, locomotive fuel consumption and delays caused by journal maintenance."

The TIMKEN "QUAD" BEARING application will be used on these 500 cars. This type of application not only is used in new cars, but because it fits into existing narrow truck frame pedestal openings, it makes possible the conversion of existing friction bearing cars with pedestal type trucks to Timken Roller Bearings.



Timken "Quad" Bearing Application.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
RAILWAY ROLLER BEARINGS

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

"BUT WHAT'S YOUR LAST NAME?"

Our last name is *Koppers*. Many of you know our "children" by their "first names," but do you know their last name?

That is important to us, and it's important to you, too.

Many of you vouch for the extra service you get from Fast's Self-aligning Couplings or American Hammered Piston Rings, or White Tar insecticides or D-H-S-Bronze . . . and don't know that their last name is Koppers. If you know, you are probably disposed to put more than ordinary trust in other products made by Koppers.

Did you know that you can get a Koppers product for coating metal surfaces to prevent corrosion? A Koppers material that makes roofs last longer? Lumber that defies decay and termites? And many other products made with the same skill and originality and inventiveness as those?

So . . . look for this trade-mark which will soon be found on all Koppers products. Here it is.

K
KOPPERS

It is the mark of an organization which is engaged in many phases of engineering, construction, chemistry and coal carbonization . . . is in the forefront of new synthetic developments . . . is an important supplier to the pharmaceutical industry and to many other industries. For top value, look for this mark. Koppers Company, Inc., Koppers Building, Pittsburgh 19, Pennsylvania.

THE INDUSTRY THAT SERVES ALL INDUSTRY

For example... for the railroad field

Among the principal products Koppers provides for the railroad field are:

Pressure-treated ties, bridge timbers, piles, poles, culverts, car lumber, station platforms, retaining walls, water tanks, etc.

Locomotive Cylinder and Valve Packing.

Automotive Piston Rings.

Piston Rings for diesel engines, and for compressors, pumps, etc.

Coal tar pitch roofing and waterproofing.

Bituminous-base paints.

Plastipitch Protected Metal roofing and siding.

Pitchmastic Flooring Compound.

Coal handling equipment.

Fast's Self-aligning Couplings.

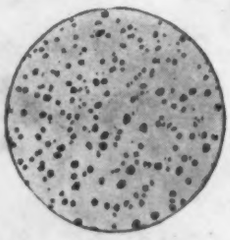
Pipe Dips.

Le Blond flame-hardened lathe bed ways

assure longer sustained accuracy!

THE RIGHT STEEL + LeBLOND FLAME-HARDENING PROCESS + COMPLETE STRESS-RELIEVING DRAW = LONGER SERVICE LIFE

friction reducing



Graphite distribution of graphitic type steel used exclusively on all LeBlond flame hardened ways.

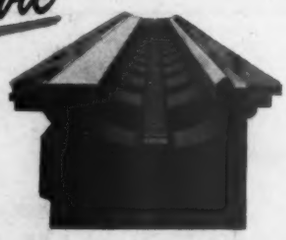
The graphitic type steel used in LeBlond flame hardened bed ways has qualities and properties equivalent to those of a high grade tool steel. The microscopic graphitic pockets, uniformly distributed throughout its structure, absorb oil, facilitating lubrication and greatly reducing friction and wear. The lubricant retained in the graphite recepticals makes carriage movement easy and accounts for the remarkable service life of the shears.

complete

After flame hardening, a stress-relieving draw is given all LeBlond bed ways to relieve the stresses set up by the hardening process. These shears test 63-66 Rockwell C (over 600 Brinell). They will outlast the useful life of the lathe. In addition, the LeBlond compensating vee-way principle is retained, supporting the carriage at a right angle to the thrust of the tools.

Cross section view. Note the uniform structure of the soft metal core, the generous depth of the hardened outer case.

replaceable



LeBlond flame hardened bed sections are joined to the bed by means of screws at intervals of six inches. It is easy to remove and replace them in the event of accidental damage.

standard equipment

LeBlond flame-hardened and ground shears are furnished as standard equipment on both front and rear ways of all heavy duty engine lathes up to and including the 32" size, on all tool room lathes, and on all hollow spindle (oil country) lathes.

In addition to the bed ways, many other LeBlond lathe parts which are subject to wear are also flame-hardened. For example, on the 25" heavy duty engine lathe, 13 separate parts . . . shafts, gears, pinions, and bars . . . are flame-hardened by the LeBlond process for greater sustained accuracy and longer life.

for further information, write

THE R. K. LE BLOND MACHINE TOOL CO., CINCINNATI 8, OHIO

LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES